

FANUC SERVO GUIDE

OPERATOR'S MANUAL

- No part of this manual may be reproduced in any form.
- All specifications and designs are subject to change without notice.

In this manual we have tried as much as possible to describe all the various matters. However, we cannot describe all the matters which must not be done, or which cannot be done, because there are so many possibilities. Therefore, matters which are not especially described as possible in this manual should be regarded as "impossible".

This manual contains the program names or device names of other companies, some of which are registered trademarks of respective owners. However, these names are not followed by ® or ™ in the main body.

SAFETY PRECAUTIONS

This manual includes safety precautions for protecting the user and preventing damage to the machine. Precautions are classified into Warning and Caution according to their bearing on safety. Also, supplementary information is described as a Note. Read the Warning, Caution, and Note thoroughly before attempting to use the machine.

 **WARNING**

Applied when there is a danger of the user being injured or when there is a damage of both the user being injured and the equipment being damaged if the approved procedure is not observed.

 **CAUTION**

Applied when there is a danger of the equipment being damaged, if the approved procedure is not observed.

NOTE

The Note is used to indicate supplementary information other than Warning and Caution.

- * Read this manual carefully, and store it in a safe place.

GENERAL WARNINGS AND CAUTIONS

The following warnings and cautions provide information that the user should bear in mind when handling the CNC to use a machine with the CNC more safely.

WARNING

- 1 SERVO GUIDE is the software for only tuning servo system. Don't use this software for normal work (cutting or etc.).
- 2 Before tuning with SERVO GUIDE, thoroughly confirm that there are no dangerous objects, for example tools, work objects and so on. When you get the data by SERVO GUIDE during cutting, please operate not from SERVO GUIDE but from NC directly. And don't send programs or change parameters through SERVO GUIDE. Don't forget to use SERVO GUIDE ONLY for measurement.
- 3 Don't connect two personal computers to one NC and operate one NC through both SERVO GUIDE. Both requests interfere each other and CNC system may behaves incorrectly.
- 4 After understanding the effect of tuning parameter very well , tune the parameter. The wrong tuning of parameters may cause the unexpected behavior of the machines.

CAUTION

SERVO GUIDE can handle command programs , parameters and so on from the personal computer side. Before using SERVO GUIDE, don't forget to make a backup of the nonvolatile memory data to provide against erasing memory by mistake.

WARNINGS AND CAUTIONS RELATING TO SERVO GUIDE

Warnings and cautions relating to SERVO GUIDE are explained in this manual. Before using SERVO GUIDE, read this manual thoroughly to become familiar with the provided warnings and cautions.

PREFACE

FANUC SERVO GUIDE is the integrated environment to make Servo & Spindle tuning easier.

SERVO GUIDE has the following features.

- Easy connection to NC
- Integrated environment for tuning for example running programs, measuring data and changing parameters
- Measurement of servo and spindle data at the same time
- Tuning navigator which includes the automatic tuning function

This software is used on Microsoft® Windows®. This manual does not explain basic operations of Windows. Users who are using Windows for the first time should read manuals on Windows first to become familiar with the basic operations of Windows.

This manual explains items specific to the servo tuning tool including information on how to install, start, and operate this software. For information about CNC operation and parameter setting, refer to the relevant manuals on the CNC used.

Read this manual thoroughly to ensure the correct use of FANUC SERVO GUIDE.

**CAUTION**

This software can be used on one computer. When this software is used on more than one computer, the user must receive as many licenses as the number of the computers used to run this software. Just one copy of this software is permitted for backup or storage. The copyrights of this software product, supplied help, and so on belong to FANUC.

- * Microsoft and Windows are registered trademarks of Microsoft Corporation in the United States of America.

ORGANIZATION OF THIS MANUAL

This manual is organized as follows:

SAFETY PRECAUTIONS

Explains the general precautions which must be observed to use SERVO GUIDE safely.

PREFACE

Briefly explains the features of SERVO GUIDE. Also explains how to use information on the usage of SERVO GUIDE, including this manual.

I. USAGE

1. **SETUP**
Explains how to set up SERVO GUIDE.
2. **CONNECTION AND COMMUNICATION WITH THE NC**
Explains how to connect a personal computer to the NC.
3. **MAIN BAR**
Explains the Main Bar of SERVO GUIDE.
4. **PARAMETER WINDOW**
Explains the Parameter Window.
5. **GRAPH WINDOW**
Explains the Graph Window.
6. **PROGRAM WINDOW**
Explains the Program Window.
7. **TUNING NAVIGATOR**
Explains Tuning Navigator.

II. CONCRETE EXAMPLES

Specifically explains how to make measurements using the three windows of SERVO GUIDE by using examples.

APPENDIX

Provides information which is to be read as necessary.

NOTATION CONVENTIONS

The following explains the notation conventions used in this manual:

- Menu, commands, and screen notations

Example	Explanation
[Menu]	Menu names are enclosed in brackets [].
[Command]	Command names are enclosed in brackets [].
[Title bar]	Screen names (displayed on the title bar) are enclosed in brackets [].
<OK> button	Command buttons on the display are enclosed in angle brackets <>.

- Key notations and operation

Example	Explanation
[Enter] key	Key names are enclosed in brackets [].
[Ctrl]+[Tab] keys	When keys are to be pressed sequentially and held down at the same time, the keys are indicated by connecting them with +, as shown on the left.
Direction keys	The [→], [←], [↑], and [↓] keys are collectively called the direction keys.

- Mouse operations

Example	Explanation
Click	Press a mouse button, then release it immediately.
Double-click	Click a mouse button twice in quick succession.
Drag	Move the mouse while holding down a mouse button, then release the button at a desired location.

- Folders

This manual refers to directories and folders collectively as folders.

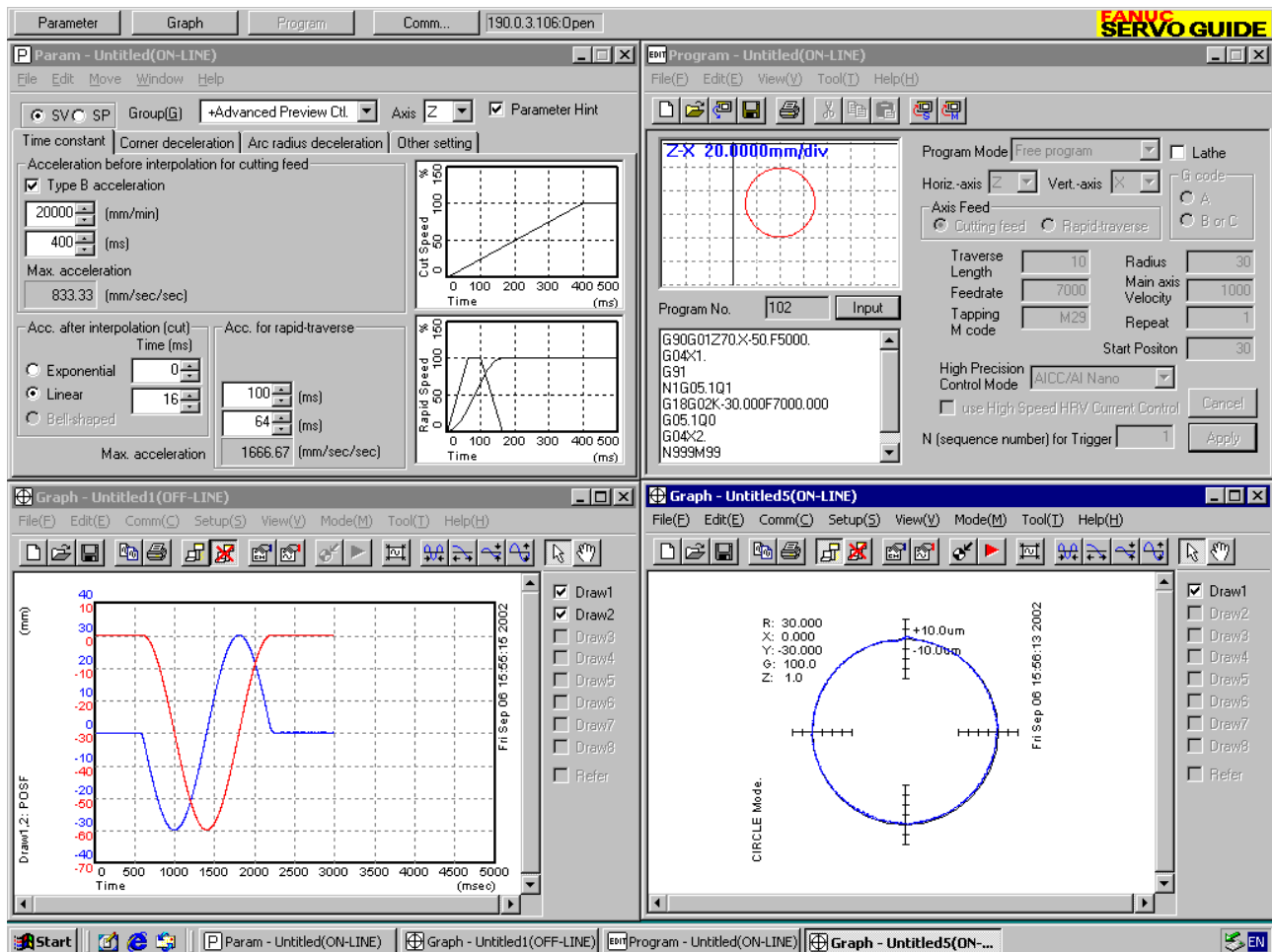
- CNC models
 In this manual, the abbreviations listed below are used. (The Power Mate *i* is included in the FS16*i* in this manual.)

CNC models	Abbreviations	
FANUC Series 30 <i>i</i> -MODEL A	Series 30 <i>i</i>	FS30 <i>i</i>
FANUC Series 31 <i>i</i> -MODEL A	Series 31 <i>i</i>	
FANUC Series 31 <i>i</i> -MODEL A5		
FANUC Series 32 <i>i</i> -MODEL A	Series 32 <i>i</i>	
FANUC Series 16 <i>i</i> -MODEL B	Series 16 <i>i</i>	FS16 <i>i</i>
FANUC Series 18 <i>i</i> -MODEL B	Series 18 <i>i</i>	
FANUC Series 18 <i>i</i> -MODEL B5		
FANUC Series 21 <i>i</i> -MODEL B	Series 21 <i>i</i>	
FANUC Series 20 <i>i</i> -MODEL B	Series 20 <i>i</i>	
FANUC Series 0 <i>i</i> -MODEL B	Series 0 <i>i</i>	
FANUC Series 0 <i>i</i> -MODEL C		
FANUC Series 0 <i>i</i> Mate-MODEL B	Series 0 <i>i</i> Mate	
FANUC Series 0 <i>i</i> Mate-MODEL C		
FANUC Power Mate <i>i</i> -MODEL D	Power Mate <i>i</i>	
FANUC Power Mate <i>i</i> -MODEL H		

FEATURES OF SERVO GUIDE

This software has the following features:

- Integrated tuning tool for tuning servo and spindle axes on a personal computer
- Easy connection by inserting a PCMCIA-LAN card on the front of the CNC
- Easy operation by GUI
- Automatic tuning by Tuning Navigator



Outline of software specifications

SERVO GUIDE consists of four software functions including three types of window, which are the Parameter Window, the Graph Window, and the Program Window, and a tuning support wizard called Tuning Navigator.

The following outlines the specifications of these software functions.

(1) Parameter Window

- Parameters on the NC are taken in, and classified and displayed for each function.
- Parameters for servo and spindle axes are supported.
- Automatic acceleration/deceleration functions for high speed and high-precision are supported.
- NC parameters can be changed on the personal computer.
 - * Multipath systems are supported by Version 3.00 and later versions.

(Details of supported functions)

Group	Description
System setting	CNC options related to servo systems are extracted and displayed.
Servo axis setting	Use of separate detector, rotary motor/linear motor, CMR, flexible feed gear, etc.
Acceleration/ deceleration	Time constant of Acc./Dec. before interpolation and time constant of Acc./Dec. after interpolation, speed difference in automatic corner deceleration, setting for arc radius-based feed rate clamp, setting for acceleration-based deceleration, Jerk control (Normal control, advanced preview control, AI advanced preview control, AI contour control, AI nano contour control, high precision contour control, AI high precision contour control, AI nano high precision contour control, AI contour control I and II)
Current control	HRV, HRV2, HRV3, and HRV4 control
Velocity control	Velocity loop gain setting, and setting of filters for eliminating machine resonance, vibration damping control, and dual position feedback
Position control	Position gain setting
Contour error suppression	Feed-forward, backlash acceleration, fine Acc./Dec. (16i series only)
Improvement in overshoot	Setting of overshoot compensation function
High-speed positioning function	Setting of FAD + advanced preview feed-forward, position gain switching function, etc.
Stop	Setting of brake control, quick stop at emergency stop, etc.
Unexpected disturbance torque detection	Adjustment of estimated disturbance value, alarm detection level
Linear motor	AMR conversion coefficient, setting of smoothing compensation

Group	Description
Spindle system setting	CNC options related to spindles are extracted and displayed.
Spindle system configuration	Motor end sensor setting, spindle end sensor setting, gear ratio (main and sub)
Normal spindle velocity control	Velocity loop gain setting, and setting of filters (main and sub) for eliminating vibration, resonance elimination filter
Rigid tapping	Command setting, velocity control setting (main and sub), position control setting, fine Acc./Dec. (16i series only)
Cs contour control	Command setting, velocity control setting, position control setting, fine Acc./Dec. (16i series only), resonance elimination filters
Orientation	Velocity control setting, position control setting, acceleration setting (high-speed orientation), resonance elimination filters
Spindle synchronous control	Velocity control setting, position control setting, resonance elimination filters

The screenshot shows the 'Param - init16.prm(OFF-LINE)' window. It features a menu bar (File, Edit, Move, Window, Help) and a toolbar with buttons for 'SP', 'Group(G)', '+Advanced Preview Ctl.', 'Axis X', and 'Parameter Hint'. Below the toolbar are tabs for 'Time constant', 'Corner deceleration', 'Arc radius deceleration', and 'Other setting'. The main area is divided into sections for 'Acceleration before interpolation for cutting feed' and 'Acc. after interpolation (cut)'. The 'Acceleration before interpolation' section includes a checked 'Type B acceleration' option, a 'Max. acc.' value of 1771 (mm/sec/sec), and a 'Time (ms)' of 400. The 'Acc. after interpolation (cut)' section has radio buttons for 'Exponential', 'Linear' (selected), and 'Bell-shaped', with a 'Time (ms)' of 16 and a 'Max. acceleration' of 1666.67 (mm/sec/sec). Two graphs are displayed: 'Cut Speed' (mm/min vs Time (ms)) and 'Rapid Speed %' (vs Time (ms)).

Parameter Window (example)

(2) Graph Window

- Data measurement display function
 - Horizontal axis time mode
 - Normal mode, first order differential mode, second order differential mode (YT mode)
 - Feed smoothness measurement mode (DXDY mode)
 - Tangent speed display mode (XTVT mode)
 - Synchronous error measurement mode (Synchro mode)
 - XY mode (Polar coordinates conversion and angular axis conversion also available)
 - Arc path error zoom mode (Circle mode)

- Contour path error zoom mode (Contour mode)
- Frequency spectrum analysis mode (Fourier mode)
- Velocity loop frequency response mode (Bode mode)

For servo and spindle axes, data measurement is possible. (Data of both servo and spindle axes can also be measured at the same time.)

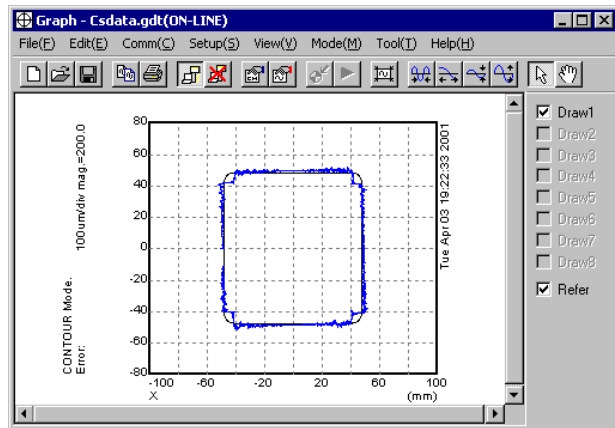
* For a spindle that is not an αI spindle, measurement data is restricted.

Up to six channels can be measured at the same time.

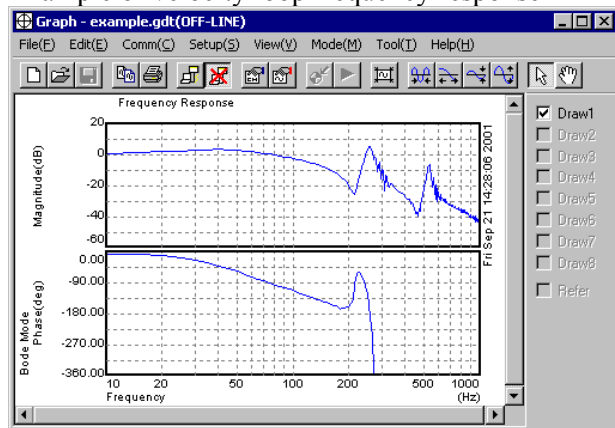
The shortest sampling period equals the current control period (for servo axes only).

Displayed data can be printed, and its bitmap can be input via the clip board.

<1> Example of contour error measurement in Cs contour axis control



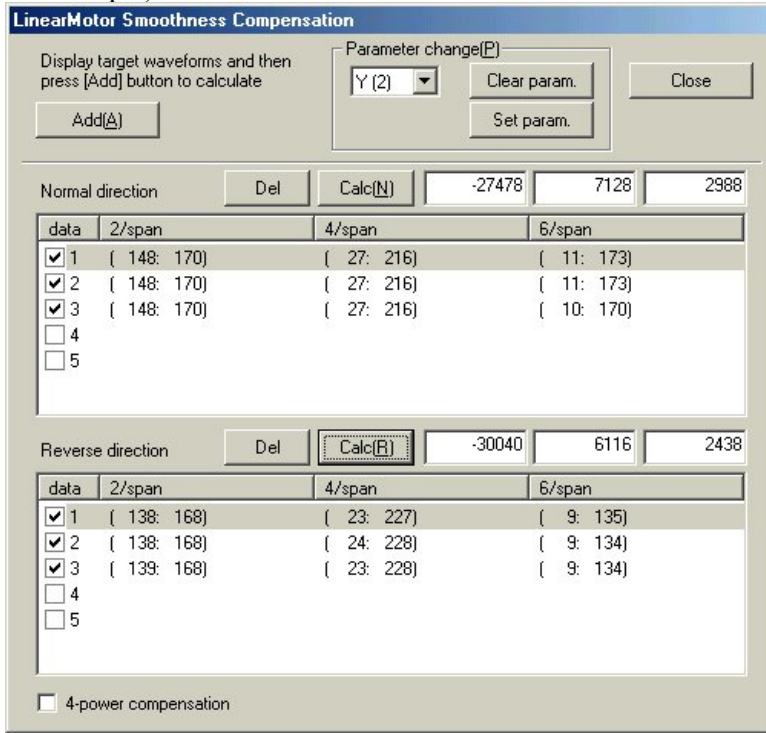
<2> Example of velocity loop frequency response



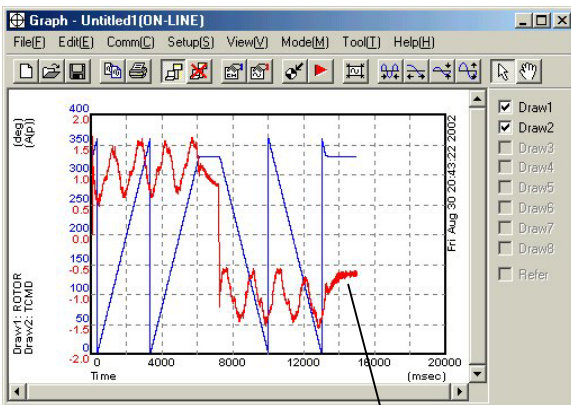
Graph Window (example)

- Function for determining linear motor smoothing compensation parameters (Version 2.00 and later versions)
 With this function, parameters of the smoothing compensation function, which improves the smoothness of linear motor feed, can be determined easily.

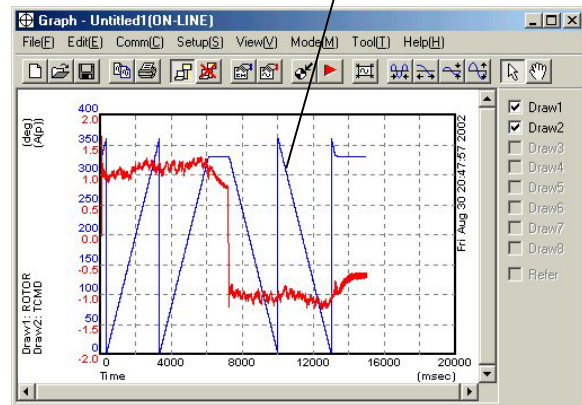
(Screen example)



(Adjustment example)



Before smoothing compensation adjustment

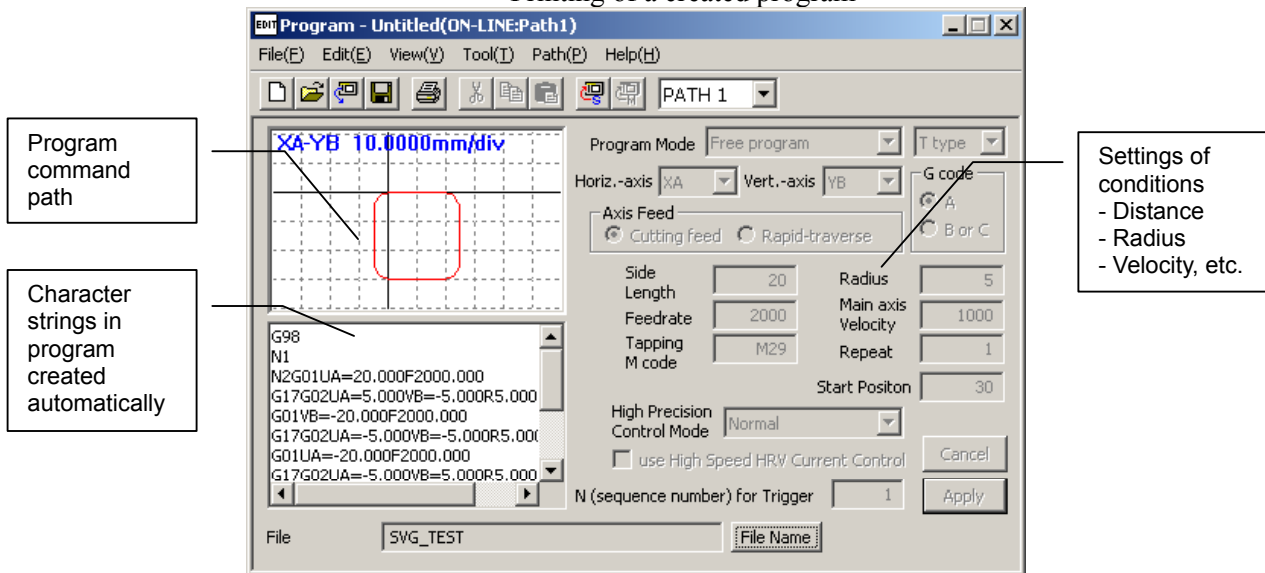


After smoothing compensation adjustment

Torque command

(3) Program Window

- Test program creation support function
 - Linear acceleration/deceleration for one axis
 - Circle
 - Square
 - Square with rounded corners
 - Rigid tapping
 - Cs contour
- Display of test program path
- Sending a test program to NC memory and executing it (The operator needs to press the start button.)
- Selecting a program in NC memory and executing it (The operator needs to press the start button.)
- Printing of a created program



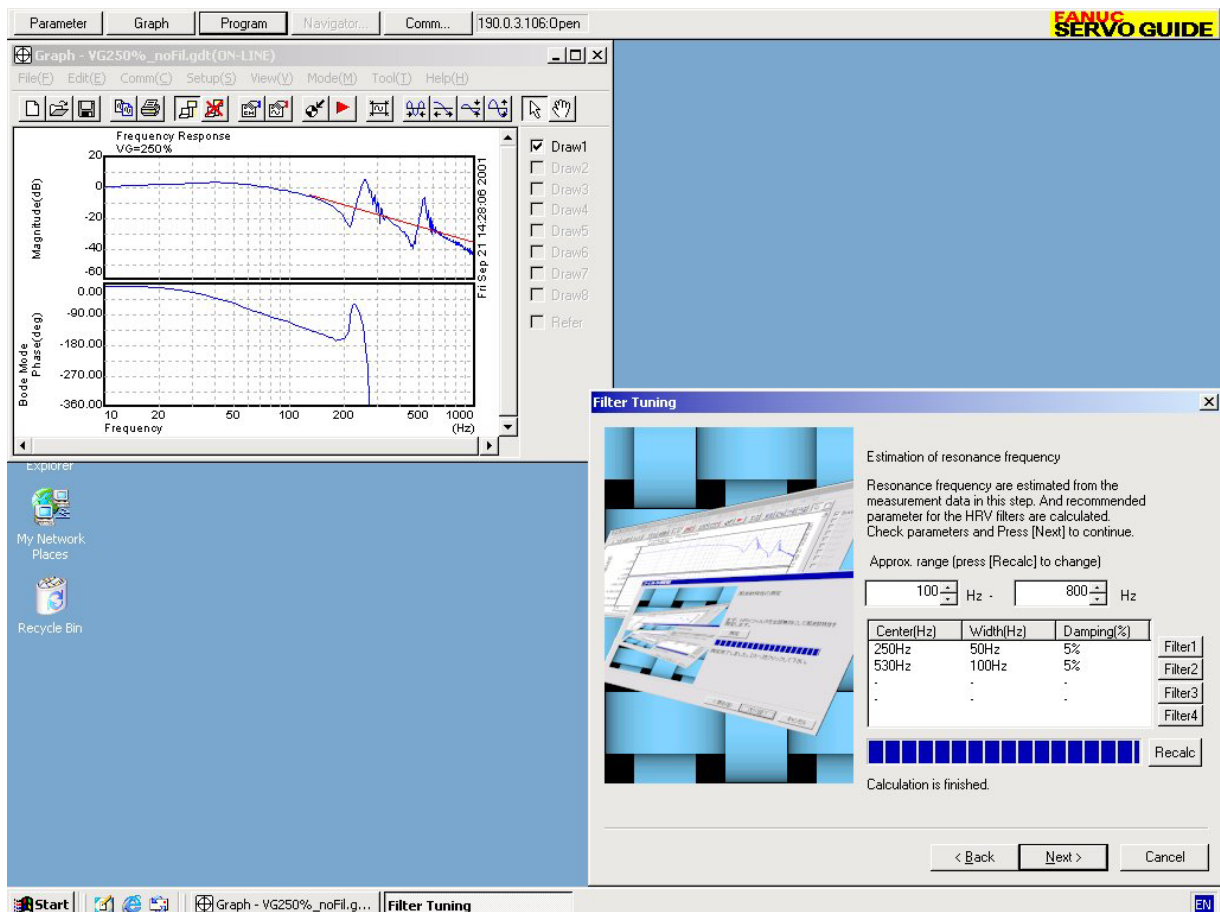
Program Window (example)

(4) Tuning Navigator

- Operating requirements
 SERVO GUIDE: Version 2.00 or later
 Servo software: Series 90B0 20th edition or later, Series 90B6, 90B5, 90B1, 90D0, and 90E0

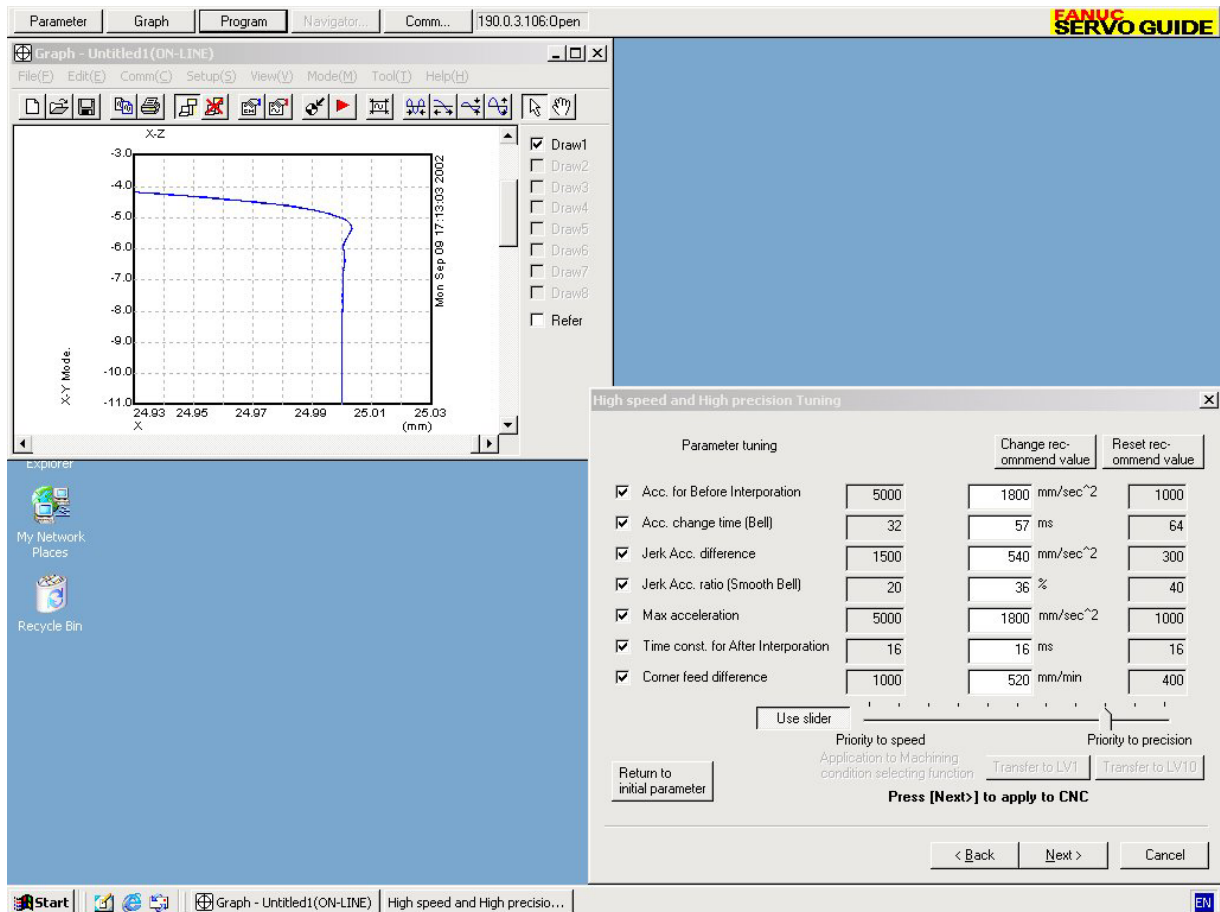
NOTE
 Tuning Navigator does not support Series 9096.

- Automatic tuning of velocity loop gain and filters
- Support of high-speed and high-precision function setting
- Automatic tuning of velocity loop gain and filters
 By measuring the frequency response of velocity control loop with moving axis, and the parameters of the velocity loop gain and resonance elimination filters are determined automatically. It is also possible to fine-tune the indicated parameter values and check the effect of the fine-tuning.



Filter adjustment (example)

- Support of high-speed and high-precision function setting
 In a program of a square with rounded corners, the high-speed and high-precision function parameters are tuned while overshoots are checked. There are tuning parameters for the high-speed and high-precision function. FANUC provides recommended parameter sets (for speed priority and precision priority), and an intermediate value between recommended parameter values can be selected easily just by using a slider.



Tuning of the high-speed and high-precision function (example)

CONTENTS OF THE PRODUCT PACKAGE

The product package of this software consists of the following:

- CD-ROM disk
FANUC SERVO GUIDE CD-ROM (A08B-9010-J900)
- CD-ROM disk (for version upgrading)
FANUC SERVO GUIDE CD-ROM (for version upgrading)
(A08B-9010-J901)

NOTE

Also read the Release Note (READMEEN.TXT) of the product package.

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I. USAGE

1

SETUP

This chapter explains how to set up the operating environment of SERVO GUIDE and how to prepare SERVO GUIDE for use.

1.1 ENVIRONMENT

The operating environment of this software is presented below. The following hardware and software configuration is required:

CNC	Series 30 <i>i</i> , 31 <i>i</i> , 32 <i>i</i> -MODEL A Series 16 <i>i</i> , 18 <i>i</i> , 21 <i>i</i> -MODEL B Series 20 <i>i</i> -MODEL B Power Mate <i>i</i> -MODEL D, H Series 0 <i>i</i> -MODEL B, 0 <i>i</i> Mate-MODEL B Series 0 <i>i</i> -MODEL C, 0 <i>i</i> Mate-MODEL C (Note 1)
Computer	IBM PC/AT COMPATIBLE, Port of Ethernet (LAN) (in case of Ethernet connection), FANUC HSSB board (in case of HSSB connection), or CNC display unit with PC functions (PANEL <i>i</i>)
CPU	Pentium 200 MHz or higher processor recommended
OS	Microsoft Windows 98/Me (Note 2) Microsoft Windows NT4.0/2000/XP (Note 3) Microsoft Windows 2000/XP is recommended. (Note 4) For browsing online help, Internet Explore 4.01 or later is required. (Note 5)
Supported language	Japanese, English, Chinese versions (Simplified, Traditional) (Chinese version is supported by Windows 2000/XP only.)
Memory	64MBytes or more (128 MBytes or more recommended)
Hard-disk space	25MBytes or more (50 MBytes on installing) (Note 6)
Display resolution	SVGA (800*600) or higher (XGA (1024*768) or higher is recommended) (Note 7)
Printer	The printers added by the printers settings on Windows
PCMCIA-LAN card (in case of Ethernet connection)	Card specified by FANUC (A02B-0281-K710) (Note 8)
Others	Cross type Ethernet cable and coupler (Required for Ethernet connection) (Note 9)

* Microsoft and Windows are trademarks of Microsoft Corporation in the United States.

* Other company and products name are either registered trademark or trademarks of each company.

NOTE

- 1 It is recommended that this software be operated on Windows 2000 or XP.
- 2 When opening multiple screens, allocate memory as large as possible.

Note 1 Series and editions of applicable system software
[System]

Series 16 <i>i</i> -MB	B0H1/05 or later
Series 16 <i>i</i> -TB	B1H1/06 or later
Series 18 <i>i</i> -MB	BDH1/05 or later
Series 18 <i>i</i> -MB5	BDH5/01 or later
Series 18 <i>i</i> -TB	BEH1/06 or later
Series 21 <i>i</i> -MB	DDH1/05 or later
Series 21 <i>i</i> -TB	DEH1/06 or later

NOTE

With the T series CNCs in the above, the following system software edition is required to measure rigid tapping synchronous errors:

Series 16 <i>i</i> -TB	B1H1/15 or later
Series 18 <i>i</i> -TB	BEH1/15 or later
Series 21 <i>i</i> -TB	DEH1/15 or later

SERVO GUIDE Version 2.00 or later

Power Mate <i>i</i> -MODEL D	88E0/18 or later
Power Mate <i>i</i> -MODEL H	88F2/01 or later
Series 0 <i>i</i> -MB	D4A1/01 or later
Series 0 <i>i</i> -TB	D6A1/01 or later
Series 0 <i>i</i> Mate-MB	D501/01 or later
Series 0 <i>i</i> Mate-TB	D701/01 or later

SERVO GUIDE Version 3.00 or later

Series 30 <i>i</i> -A	G001/23 or later, G011/23 or later, G021/23 or later G00A/01 or later, G01A/01 or later, G02A/01 or later G002/01 or later, G012/01 or later, G022/01 or later
Series 31 <i>i</i> -A	G101/01 or later G111/01 or later
Series 31 <i>i</i> -A5	G101/01 or later, G111/01 or later
Series 32 <i>i</i> -A	G201/01 or later
Series 20 <i>i</i> -FB	D0H1/01 or later
Series 20 <i>i</i> -TB	D1H1/01 or later
Series 0 <i>i</i> -MC	D4B1/01 or later
Series 0 <i>i</i> -TC	D6B1/01 or later
Series 0 <i>i</i> Mate-MC	D511/01 or later
Series 0 <i>i</i> Mate-TC	D711/01 or later

[Ethernet & OPEN CNC]

For Series 30*i*,31*i*,32*i*

656E/06 or later & 656F/07 or later

For Series 30*i*,31*i*,32*i* (for 15" color LCD)

Control software 1 for 15" color LCD

A02B-0207-J595#60VB 1.3 or later

For Series 310*is*,310*is*,320*is*

WindowsCE.NET customize OS

A02B-0207-J594 1.2 or later

Windows CE.NET FOCAS2/HSSB library

A02B-0207-J808 1.2 or later

WindowsCE.NET standard application & library

A02B-0207-J809 1.2 or later

For Series 16*i*,18*i*,21*i*,0*i*

656A/03 or later (656A/04 or later when sub-CPU is provided)

For 0*i*, 656A/05 or later is required.

656A/07 does not allow use of the PCMCIA LAN card.

For Power Mate *i*

6567/01 or later

[Servo]

For Series 30*i*,31*i*,32*i*

90D0/03(C) or later, 90E0/03(C) or later

For Series 16*i*,18*i*,21*i*,20*i*,0*i*,Power Mate *i*

90B0/06(F) or later

(When Tuning Navigator is used, 90B0/20(T) or later is required.)

90B6/01(A) or later, 90B5/01(A) or later, 90B1/01(A) or later

For Series 21*i*, 0*i*, Power Mate *i*

9096/01(A) or later (not supported by Tuning Navigator)

[Spindle]

For Series 30*i*,31*i*,32*i*

9D70/02 or later (for α series SPM)

For Series 16*i*,18*i*,21*i*,0*i*,Power Mate *i*

9D50/02 or later (for α series SPM)

For Series 16*i*,18*i*,21*i*,0*i*,Power Mate *i*

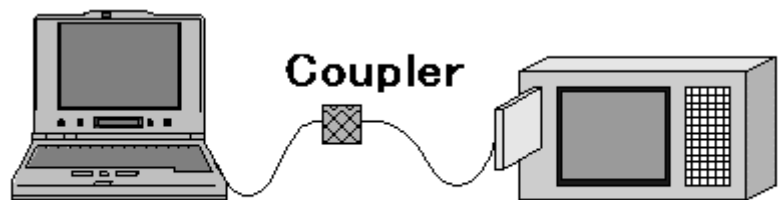
9D20/11 or later (for α series SPM)

(Using α series SPM, there is the restriction of function for getting data)

You may be able to use SERVO GUIDE with any other software. But we assure the correct working with α series in above combination.

With SERVO GUIDE Version 3.00 and later versions, the Parameter Window and Program Window also support multi-path CNC systems.

- Note 2 Operation on Windows 95 has not been confirmed.
- Note 3 When using this software under the Windows NT 4.0, install the "Service Pack 3" or later. Get this software from Microsoft Corporation.
- Note 4 In Windows 98/Me, since it may become resource shortage when two or more parameter windows, graph windows, etc. are opened simultaneously, we recommend to use Windows 2000/XP.
- Note 5 If Internet Explorer 4.01 or later cannot be found, Online help cannot be displayed.
- Note 6 In addition, the space for storing measurement data is required.
- Note 7 Although SVGA also can be used, when two or more windows are opened simultaneously, it becomes hard to see by window overlap.
- Note 8 When using "is Series" CNC with Windows CE (160is, 180is, 210is), LAN card can't be used for connecting PC and CNC to use "SERVO GUIDE". Then LAN card is not necessary, and use embedded Ethernet port behind CNC.
The *is* series (300i, 310is, and 320is) in the Series 30i also allows the use of the LAN card for connection.
When the LAN card is used with the Power Mate *i*, an Ethernet board must be inserted in the NC. In this case, the PCMCIA-LAN card is not necessary. Prepare the following:
- Fast Ethernet board (A02B-0259-J293)
 - Fast Ethernet option (A02B-0259-J862)
 - Ethernet software (A02B-0259-J555#6567)
 - Expansion basic 1 function option (A02B-0259-J878)
 - Expansion driver/library (A02B-0259-J847)
- Note 9 The LAN card provided by FANUC is supplied with a straight type cable with an RJ45 male connector. The PC and the NC are connected directly as shown below.



Cross type Cable Straight type cable

(The cross type cable and coupler are commercially available from ordinary stores dealing in personal computers.)

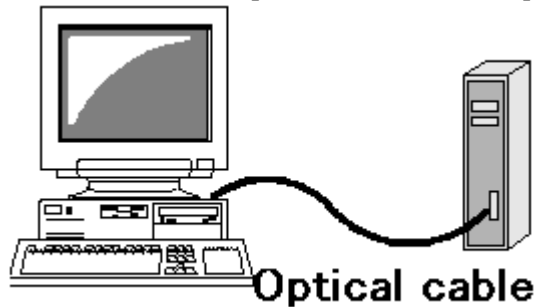
When the PC and the NC are connected via a hub, they are connected as shown in the figure below. In this case, the coupler becomes unnecessary, but a straight type cable must be prepared.



Straight type cable Straight type cable

When HSSB is used, the CNC and the PC are connected using an optical cable as shown in the figure below. So, no special connection must be added to use SERVO GUIDE.

* Also when a CNC display unit with a PC function such as the FS160i is used, no special connection is required.



1.2 INSTALLATION AND UNINSTALLATION

This section explains how to install and uninstall SERVO GUIDE. When Windows NT 4.0, 2000, or XP is used, login with an account having the administrator right must be performed before software setup.

1.2.1 Installation Procedure

When using SERVO GUIDE for the first time, install it according to the following procedure:

- (1) Insert the installation disk (A08B-9010-J900) of SERVO GUIDE in the CD drive.
- (2) Open the CD drive from [My Computer], and double-click "Setup.exe" to perform setup.

NOTE

When Setup.exe is executed with a previous SERVO GUIDE version installed, the files of the previous version are all deleted and updated to the latest files. (Version upgrading)

- (3) SERVO GUIDE setup starts, and the [Select Language] screen appears. Select the language of the OS used, and click the <OK> button.

NOTE

As the display language of the software, the language of the OS used or English can be selected. (When the language of the OS is English or is a language not supported, only English can be selected in SERVO GUIDE.)

- (4) Perform subsequent operations according to the instructions of the installer.
 - * Restart may be required.

1.2.2 Installing the Upgrading Version

The user who uses a previous SERVO GUIDE version can upgrade SERVO GUIDE to the latest version by purchasing the upgrading software version.

NOTE

If a previous software version is not installed in the PC correctly, the upgrading software version cannot be installed.

If the previous SERVO GUIDE version is installed in the PC correctly, install the upgrading version by observing the following procedure:

- (1) Insert the SERVO GUIDE installation disk (A08B-9010-J901) in the CD drive.
- (2) Open the CD drive from [My Computer], and double-click "Setup.exe" to perform setup.

1.2.3 Deleting Setting Information

SERVO GUIDE stores settings (such as an IP address) are made during operation in the registry so that they can be used for the next execution. To erase setting information to restore the initial state, execute Cleaner.exe.

Cleaner.exe can be used from the [FANUC SERVO GUIDE] group in the start menu.

When more than one user name is used for login, setting information remains in the environments of other than the user of which name is used for executing Cleaner.exe.

NOTE

Setting information is stored under the following registry key:
HKEY_CURRENT_USER\Software\FANUC\SERVO GUIDE\

1.2.4 Uninstallation Procedure

- (1) Ending SERVO GUIDE
SERVO GUIDE cannot be uninstalled while SERVO GUIDE is running. End SERVO GUIDE before starting uninstallation.
- (2) Erasing setting information
Execute [Cleaner] in the [FANUC SERVO GUIDE] group in the [Start] menu. This erases SERVO GUIDE setting information stored in the registry.
- (3) Starting the uninstaller
Select "FANUC SERVO GUIDE" from [Add or Remove Programs] on the Control Panel, and press the <Change or Remove Programs> button.

2

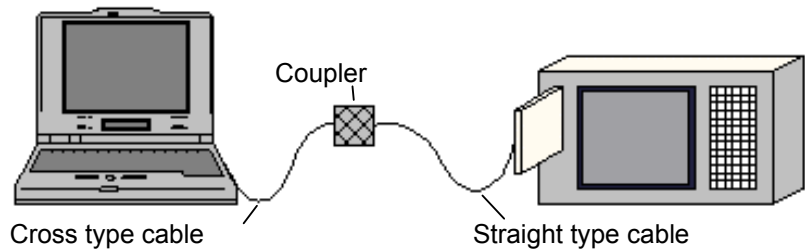
CONNECTION AND COMMUNICATION WITH THE NC

2.1 VIA ETHERNET

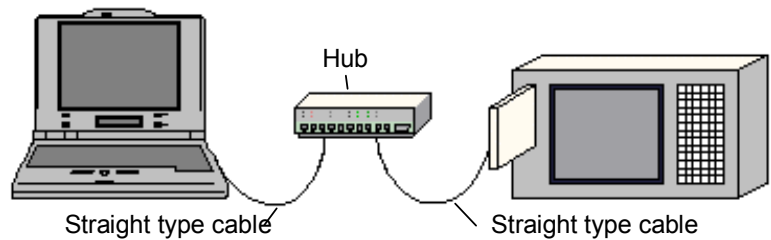
2.1.1 Connection

The PCMCIA-LAN card, which is provided by FANUC, includes 1.5m special cable which has exclusive connector for card side and RJ45 male connector for PC side. The connection way is different according to using Hub or not using Hub.

Without Hub



With Hub



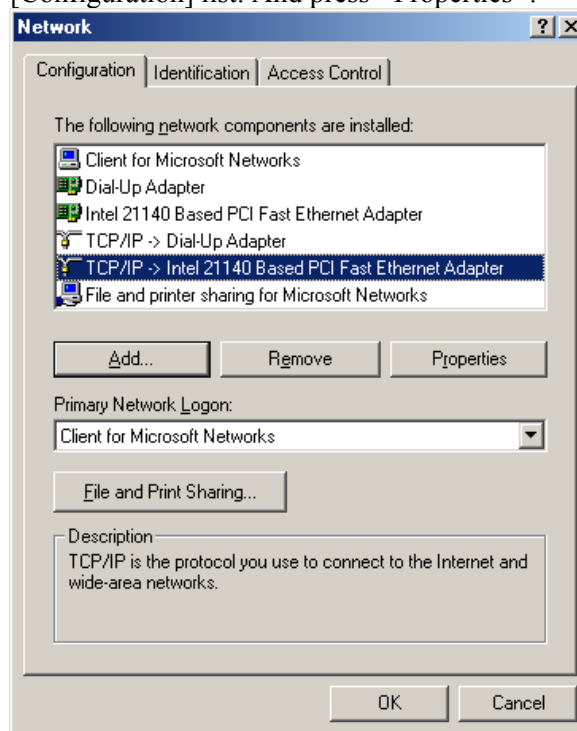
- * When you use embedded Ethernet port on CNC, you don't have to use PCMCIA-LAN card and please use RJ45 connector on CNC.

2.1.2 Setting of PC

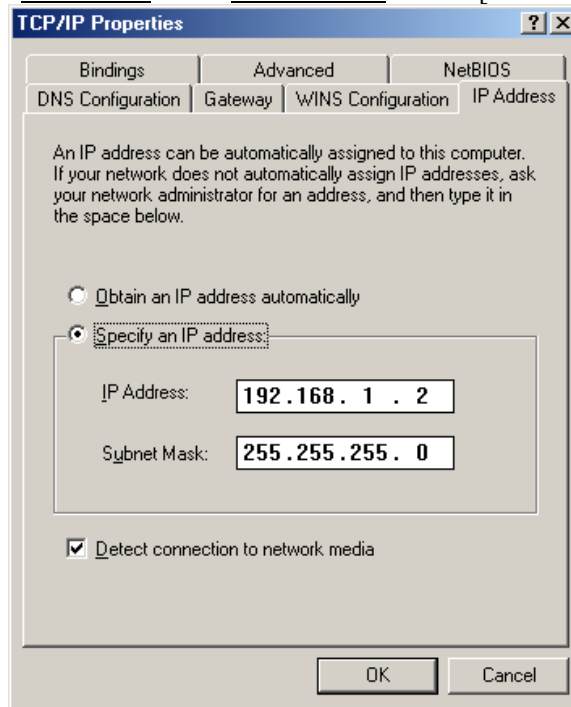
Windows 98, Windows Me

It's necessary to do some setting both on PC and CNC because SERVO GUIDE communicate with CNC by using PCMCIA-LAN card.

- When your PC is usually connected to LAN,
 1. Press right click on [Network Neighborhood] on your desktop. And after that, select <Properties>. You can see the dialog to set some network setting.
 2. Select [TCP/IP->xxxx Ethernet Adapter] in the [Configuration] list. And press <Properties>.



3. [TCP/IP Properties] will be shown. Remember the value of "IP Address" and "Subnet Mask" in the [IP Address] tab.



Shut down the dialog by press <Cancel>. (You don't have to change any item.)

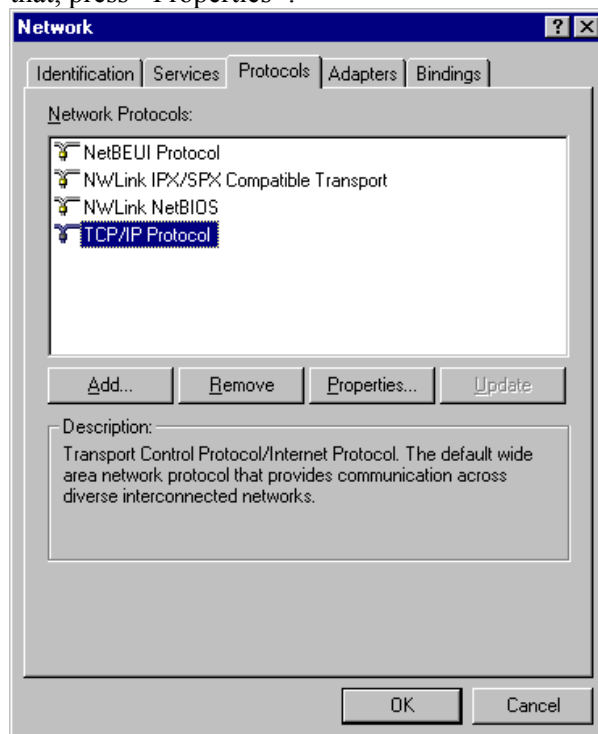
- When your PC is not usually connected to LAN,
 1. First, install appropriate software so that the LAN card or built-in LAN connector on the PC side can operate. (For the installation method, see the operator's manual of the LAN card or PC.)
 2. See [TCP/IP Properties] dialog like above.
 3. Set following value.
IP Address: 192.168.1.2
Subnet Mask: 255.255.255.0
 4. Shut down the dialog by press <OK>.

After completing the setting of the PC, proceed to the setting of the NC.

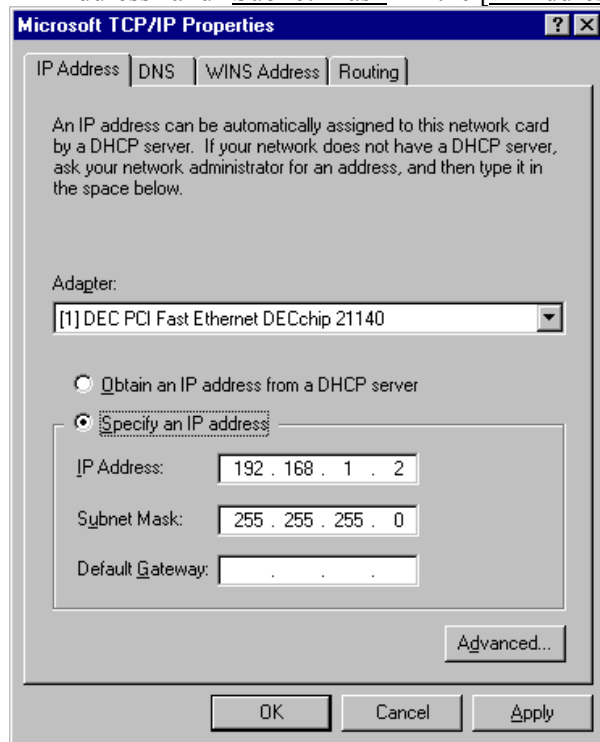
Windows NT4.0

It's necessary to do some setting both on PC and CNC because SERVO GUIDE communicate with CNC by using PCMCIA-LAN card.

- When your PC is usually connected to LAN,
 1. Press right click on [Network Neighborhood] or [My Network Place]]on your desktop. And after that, select <Properties>. You can see the dialog to set some network setting.
 2. Select [Protocol] tab and select [TCP/IP Protocol]. After that, press <Properties>.



3. [TCP/IP Properties] will be shown. Remember the value of "IP Address" and "Subnet Mask" in the [IP Address] tab



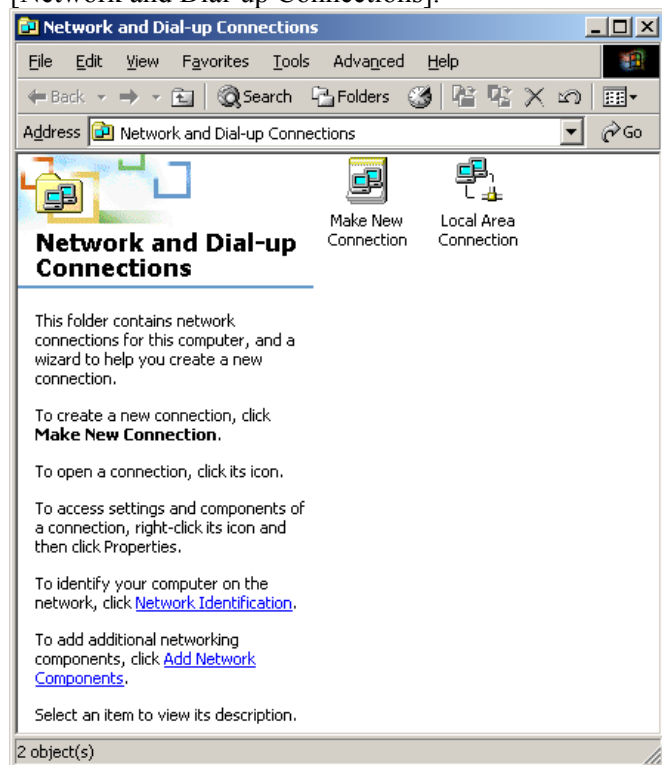
4. Shut down the dialog by press <Cancel>. (You don't have to change any item.)
- When your PC is not usually connected to LAN,
 1. First, install appropriate software so that the LAN card or built-in LAN connector on the PC side can operate. (For the installation method, see the operator's manual of the LAN card or PC.)
 2. See [TCP/IP Properties] dialog like above.
 3. Set following value.
IP Address: 192.168.1.2
Subnet Mask: 255.255.255.0
 4. Shut down the dialog by press <OK>.

After completing the setting of the PC, proceed to the setting of the NC.

Windows 2000

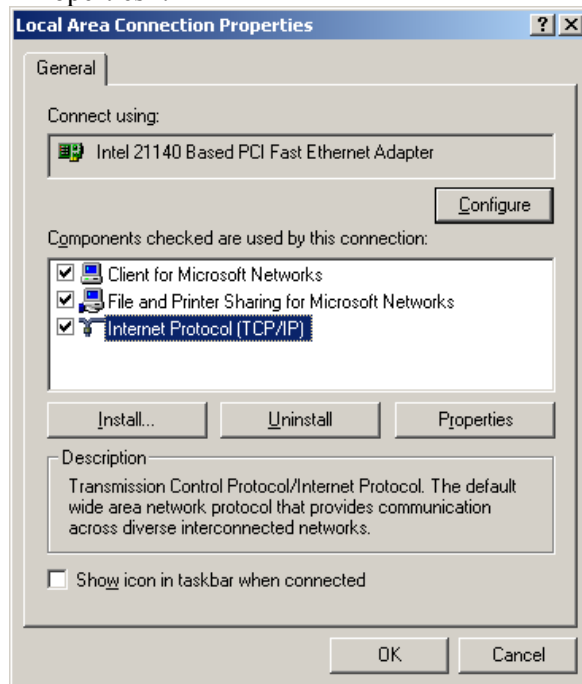
It's necessary to do some setting both on PC and CNC because SERVO GUIDE communicate with CNC by using PCMCIA-LAN card.

- When your PC is usually connected to LAN,
 1. Press right click on [My Network Place] on your desktop. And after that, select [Properties]. You can see the folder of [Network and Dial-up Connections].

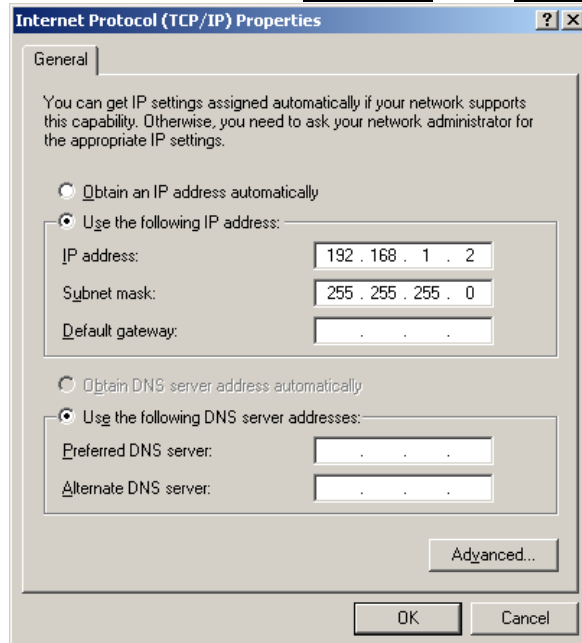


2. Press right click on [Local Area Connection] and select [Properties]. You can see the dialog of [Local Area Connection Properties].

3. Select [Internet Protocol TCP/IP] in the list box. And press <Properties>.



4. [Internet Protocol (TCP/IP) Properties] will be shown. Remember the value of "IP Address" and "Subnet Mask".



Shut down the dialog by press <Cancel>. (You don't have to change any item.)

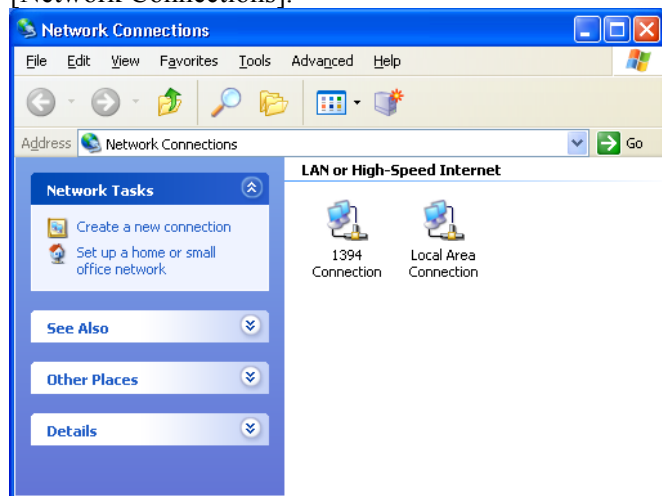
- When your PC is not usually connected to LAN,
 1. First, install appropriate software so that the LAN card or built-in LAN connector on the PC side can operate. (For the installation method, see the operator's manual of the LAN card or PC.)
 2. See [Internet Protocol (TCP/IP) Properties] dialog like above.
 3. Set following value.
IP Address: 192.168.1.2
Subnet Mask: 255.255.255.0
 4. Shut down the dialog by press <OK>.

After completing the setting of the PC, proceed to the setting of the NC.

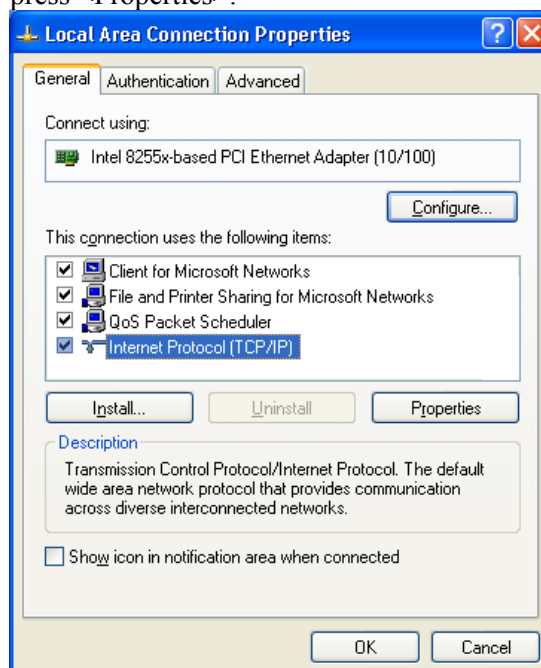
Windows XP

It's necessary to do some setting both on PC and CNC because SERVO GUIDE communicate with CNC by using PCMCIA-LAN card.

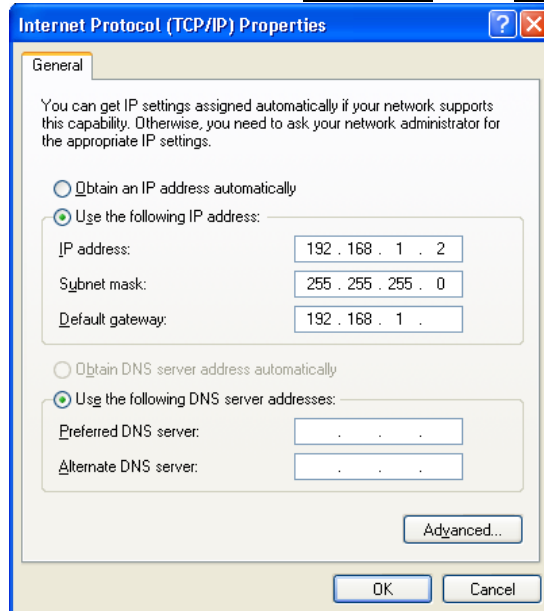
- When your PC is usually connected to LAN,
 1. Press right click on [My Network Place] on your desktop. And after that, select [Properties]. You can see the folder of [Network Connections].



2. Press right click on [Local Area Connection] and select [Properties]. You can see the dialog of [Local Area Connection Properties].
3. Select [Internet Protocol (TCP/IP)] in the list box. And press <Properties>.



4. [Internet Protocol (TCP/IP) Properties] will be shown. Remember the value of "IP Address" and "Subnet Mask".



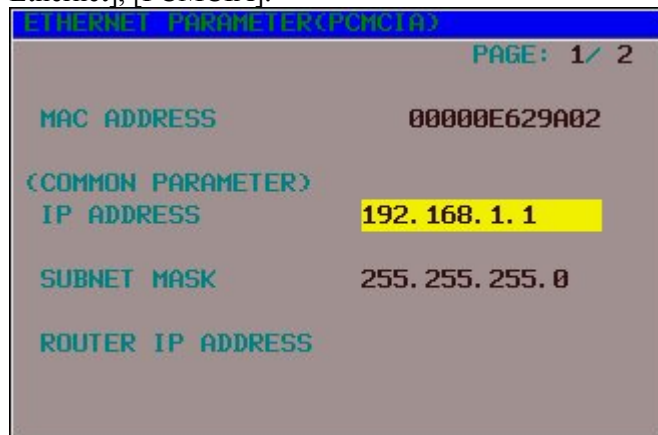
5. Shut down the dialog by press <Cancel>. (You don't have to change any item.)
- When your PC is not usually connected to LAN,
 1. First, install appropriate software so that the LAN card or built-in LAN connector on the PC side can operate. (For the installation method, see the operator's manual of the LAN card or PC.)
 2. See [Internet Protocol (TCP/IP) Properties] dialog like above.
 3. Set following value.
IP Address: 192.168.1.2
Subnet Mask: 255.255.255.0
 4. Shut down the dialog by press <OK>.

After completing the setting of the PC, proceed to the setting of the NC.

2.1.3 Setting of NC

Series 16i, 18i, 21i, 20i, 0i

1. Insert the PCMCIA-LAN card in the card slot on the front of the NC display unit.
(When using the 0i-B, insert the PCMCIA LAN card in the card slot of the NC.)
2. Press <SYSTEM> on MDI keys. And press [>] soft key several times. You can see [ETHPRM], [ETHMNT], [(OPRT)] on the soft key menu.
3. Press [ETHPRM]. And confirm the display of [PCMCIA] as Available Ethernet.
If the display is [EMBEDDED], press [ETHPRM] → [OPRT] → [SWITCH] → {PCMCIA} → [EXEC] → [RETURN].
4. Press [PCMCIA] soft key on the display which shows [Available Ethernet], [PCMCIA].



5. The initial setting of CNC is as follows.
IP ADDRESS: 192.168.1.1
SUBNET MASK: 255.255.255.0
 - <1> When your PC is not usually connected to LAN, we think you set "192.168.1.xxx" as IP address. If it's correct, you don't have to change any setting on this display.
 - <2> When your PC is usually connected to LAN, change the setting of IP address of NC according to the IP address of your PC.
Set same value as your PC as SUBNET MASK
For IP address, set same value as your PC at the place where SUBNET MASK is set "255". And you can set arbitrary value at the place where SUBNET MASK is set "0". (But the value is different from your PC.)

Example

Your PC has "190.0.3.1" as IP address and "255.255.0.0" as subnet mask.

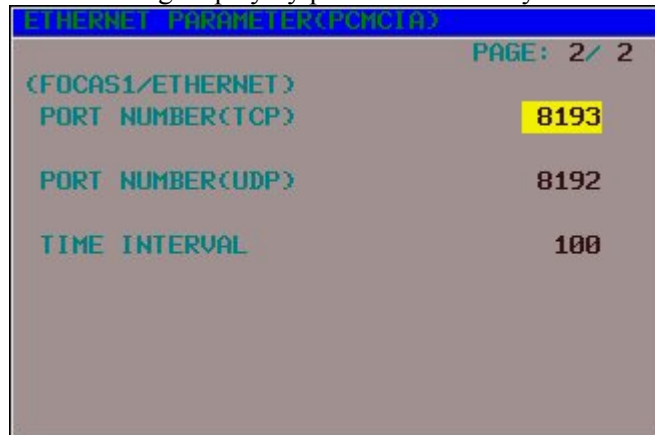
NC setting

IP ADDRESS: 190.0.3.2

↑ You can set any other value among 190.0.xxx.000 (But xxx.000=3.1 is not acceptable.)

SUBNET MASK: 255.255.0.0

6. See following display by press <PAGE> key.



7. Set "8193" as PORT NUMBER(TCP)
8. Note down the IP address and TCP port number set in the NC. It's necessary to do the setting of SERVO GUIDE.

NOTE

You can't connect between PC and NC by using PCMCIA-LAN card in Open CNC (160*is*, 180*is*, 210*is*) which use Windows CE. Use embedded Ethernet port for the NC. (Of course, use internal LAN port for the cable connection.)

Power Mate *i*

For the Power Mate *i*, use the fast Ethernet board to connect the NC to the PC. The settings to be made are the same as for other NCs.

NOTE

When the system has no display unit, make Ethernet settings by using the rotary switch, 7-segment LED indicators, and push switch of the NC.

For details on the setting method, refer to "FANUC Power Mate *i*-MODEL D/H Maintenance Manual" (B-63175EN).

Series 30i, 31i, 32i

1. Insert the PCMCIA-LAN card in the card slot on the front of the NC display unit.
2. Press <SYSTEM> on MDI keys. And press [>] soft key several times. You can see [EMBED], [PCMCIA LAN], [(OPRT)] on the soft key menu.
3. Press [PCMCIA LAN], then press [COMMON]. If the display is [EMBEDDED], press [(OPRT)] → [EMB/PCMCIA] → [EXECUTE]. The available device must become PCMCIA.

The screenshot shows a menu titled "COMMON: Setting [PCMCIA]" with a "BASIC" section. The menu items and their values are as follows:

Field	Value
MAC ADDRESS	
IP ADDRESS	192.168.1.1
SUBNET MASK	255.255.255.0
ROUTER IP ADDRESS	
AVAILABLE DEVICE	PCMCIA 1/2

4. The initial setting of CNC is as follows.
 IP ADDRESS: 192.168.1.1
 SUBNET MASK: 255.255.255.0
 <1> When your PC is not usually connected to LAN, we think you set "192.168.1.xxx" as IP address. If it's correct, you don't have to change any setting on this display.
 <2> When your PC is usually connected to LAN, change the setting of IP address of NC according to the IP address of your PC.
 Set same value as your PC as SUBNET MASK
 For IP address, set same value as your PC at the place where SUBNET MASK is set "255". And you can set arbitrary value at the place where SUBNET MASK is set "0". (But the value is different from your PC.)

Example

Your PC has "190.0.3.1" as IP address and "255.255.0.0" as subnet mask.

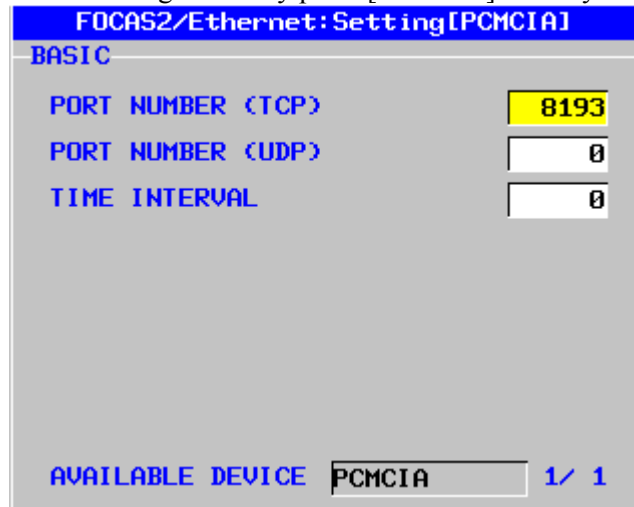
NC setting

IP ADDRESS: 190.0.3.2

↑ You can set any other value among 190.0.xxx.000 (But xxx.000=3.1 is not acceptable.)

SUBNET MASK: 255.255.0.0

5. See following screen by press [FOCAS2] soft key.



FOCAS2/Ethernet: Setting [PCMCIA]
BASIC

PORT NUMBER (TCP)	8193
PORT NUMBER (UDP)	0
TIME INTERVAL	0

AVAILABLE DEVICE PCMCIA 1/1

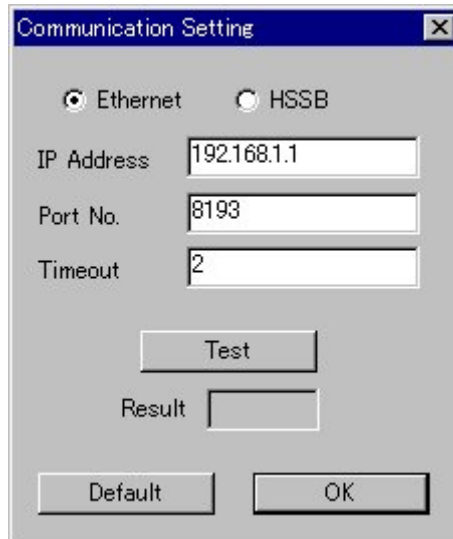
6. Set "8193" as PORT NUMBER(TCP).
7. Note down the IP address and TCP port number set in the NC.
It's necessary to do the setting of SERVO GUIDE.

NOTE

You can connect between PC and NC by using PCMCIA-LAN card in Open CNC (300is, 310is, 320is) which use Windows CE .NET.

2.1.4 Setting of SERVO GUIDE

Display following dialog by press [Comm...] on Main Bar.



- When the <Default> button is pressed, the values factory-set for the NC (IP address = 192.168.1.1, Port No. = 8193) are set.
- When you change IP address on NC, change above setting according to the setting on NC.
- Set wait time for Timeout. (The unit is sec.)
We think that 2 or 3 is enough.
- Press <Test> after you connect between PC and NC and set all above items. You'll see "OK" when they are communicating.
- If you see "NG" at the test, confirm following items.
 - Are the kind of cables correct or not ? (cross or straight)
 - Are the settings of IP address and Subnet mask correct both on NC side and PC side.
 - Are the above settings of SERVO GUIDE correct ?

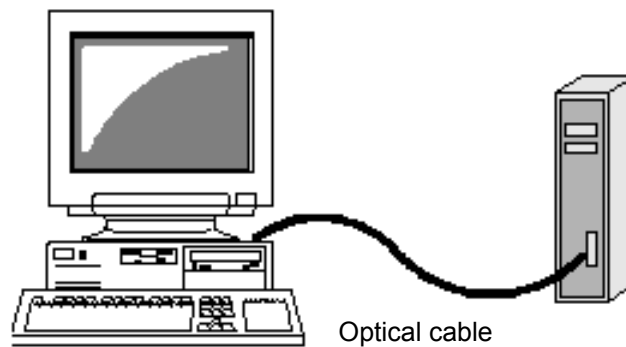
2.1.5 Additional Information about Ethernet Connection

- SERVO GUIDE assumes that for Ethernet connection, the PCMCIA-LAN card is inserted in the PCMCIA card slot on the front of the NC. However you can use embedded Ethernet port, which is on the back of NC. In this case switch "AVAILABLE ETHERNET" to "EMBEDDED" on [ETHPRM] screen.
- When an open CNC supporting Windows (160i, 180i, 210i, 300i, 310i, or 320i) or an open CNC supporting Windows CE (160is, 180is, or 210is) is used, Ethernet connection between the NC and the PC cannot be made by inserting the PCMCIA-LAN card in the PCMCIA card slot on the front of the NC. Switch "AVAILABLE ETHERNET" to "EMBEDDED".
When an open CNC supporting Windows CE.NET (300is, 310is, or 320is) is used, on the other hand, Ethernet connection can be made by inserting the PCMCIA-LAN card in the PCMCIA card slot on the front of the NC.
- If your CNC is connected to LAN in your factory, you can connect PC with CNC by straight cable via Hub. In this case pay attention not to conflict IP address against any other instruments (PC, Printer, CNC, etc.).
- Embedded Ethernet and PCMCIA Ethernet are mutually exclusive.
For a machine that is normally used by connecting it to the LAN of a plant through the embedded Ethernet, when the PCMCIA Ethernet is enabled to use SERVO GUIDE, the Ethernet on the embedded port stops service. As a result, LAN services using the embedded port are not available while SERVO GUIDE is being used.

2.2 VIA HSSB

2.2.1 Connection

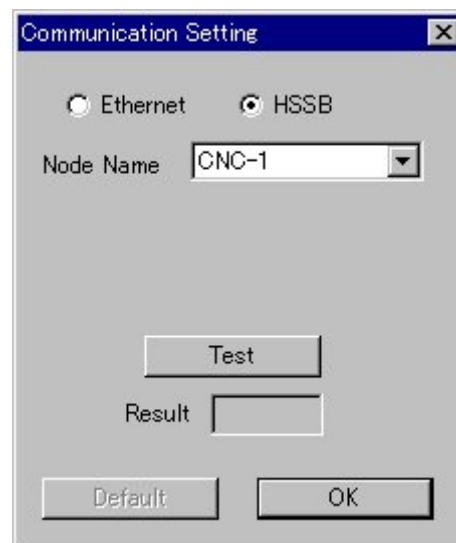
When HSSB is used, the CNC and PC are connected using an optical cable as shown in the figure below. So, no special connection must be added to use SERVO GUIDE.



- * Similarly, when SERVO GUIDE is installed in an open CNC supporting Windows (160i, 180i, 210i, 300i, 310i, or 320i), no special connection must be added.

2.2.2 Setting of SERVO GUIDE

Click [HSSB] button on the communication setting dialog, and select CNC node name to connect.



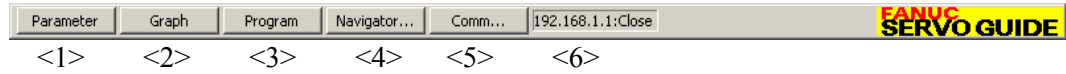
3

MAIN BAR



The Main Bar is displayed first when the SERVO GUIDE is started. The three windows used for adjustments (the Parameter Window, the Graph Window, and the Program Window) and Tuning Navigator are started from the Main Bar. Setting of communication with the CNC is also started from the Main Bar.

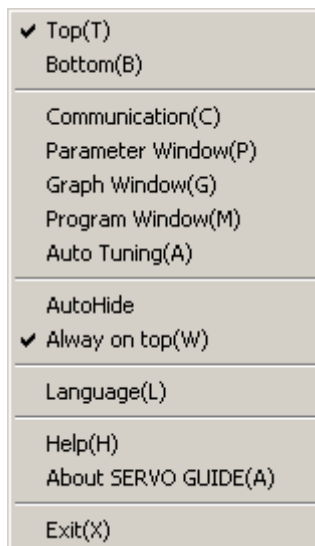
3.1 MAIN BAR STRUCTURE



- <1> <Parameter>
Start Parameter Window.
- <2> <Graph>
Start Graph Window.
- <3> <Program>
Start Program Window.
- <4> <Navigator...>
Start Tuning Navigator.
- <5> <Comm...>
Start dialog for setting of the target NC.
- <6> Status display
Display the IP address of the CNC with which SERVO GUIDE communicates, and the communication status.

3.2 EXPLANATION OF THE MENU

When you press right click on Main Bar, you can see the following menu.



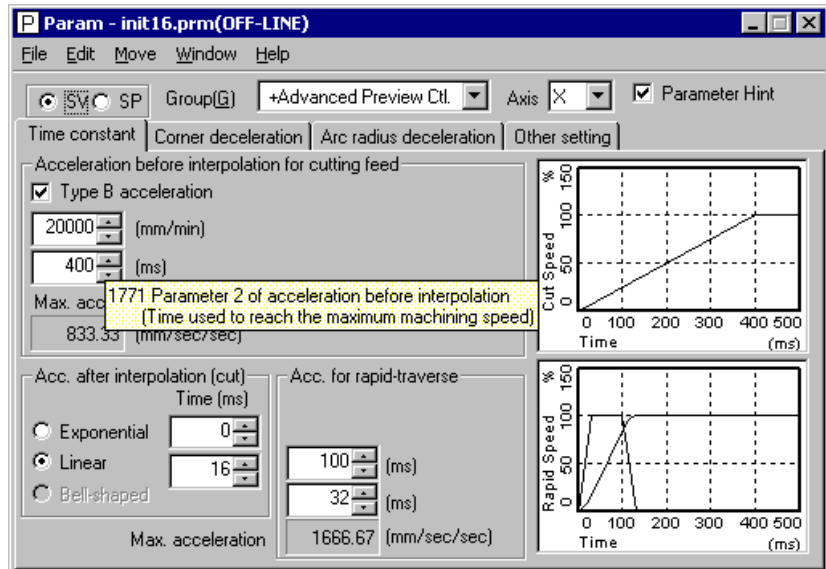
Menu	Description
[Top], [Bottom]	Specify the place of Main Bar.
[Communication]	Start dialog for setting of the target NC.
[Parameter Window]	Start Parameter Window.
[Graph Window]	Start Graph Window.
[Program Window]	Start Program Window.
[Auto Tuning]	Start Tuning Navigator.
[AutoHide]	Specify the auto-hide mode of Main Bar.
[Always on top]	Specify the pile of windows.
[Language]	Start dialog for setting of the language. The support languages are English, Japanese, Chinese (Simplified) and Chinese (Traditional). You can choose the language, English or OS language.
[Help]	Show Online Help.
[About]	SERVO GUIDE Show about dialog.
[Exit]	Terminate SERVO GUIDE.

If you select [Exit], all windows of SERVO GUIDE will be shut down at the same time. There may be some [Save] dialogs.

The positions and sizes of windows that are open when [Exit] is selected are saved in the registry, and these values are used when individual windows are opened when SERVO GUIDE is operated next.

4

PARAMETER WINDOW



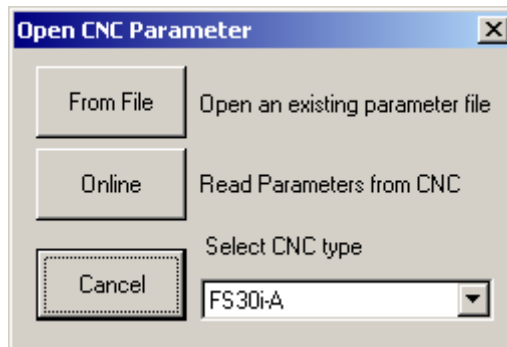
The Parameter Window is used to classify parameters on the NC by function and display them.

This window indicates the physical units of parameters explicitly and shows graphs to help the user understand the meanings of parameters. When the NC is connected, parameters may be changed directly from this window.

4.1 OVERVIEW

Starting the Parameter Window

When you press <Parameter> on Main Bar, the following dialog box is shown.



- <From File> button
When you press <From File>, the existing parameter file can be opened. (OFF LINE mode) Unfortunately parameter file does not have the information of CNC type, then CNC type is estimated by parameter format and parameter number, but CNC type is not always determined. And it is recommended to select a suitable CNC type before opening parameter file
- <Online> button
When you press <Online> during connecting to NC, the parameters inside NC are loaded into the Parameter Window without selecting the CNC type. (ONLINE mode)

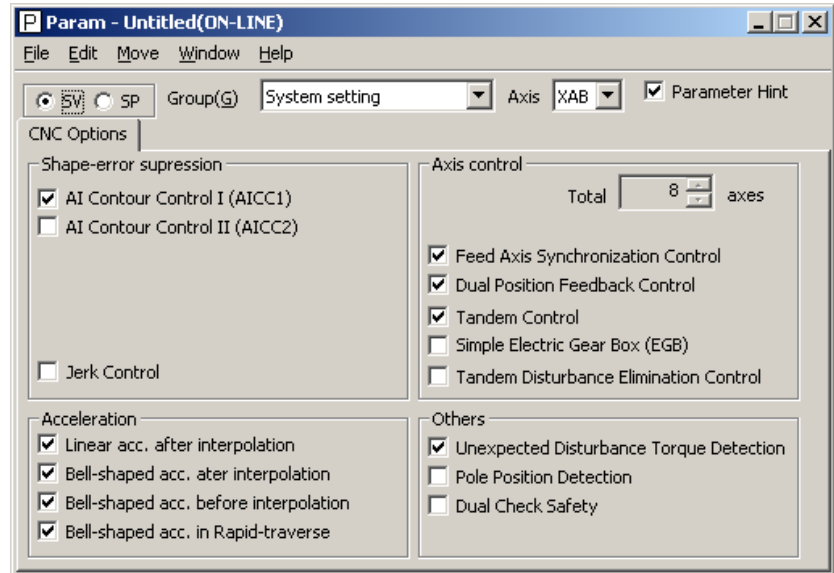
NOTE

Use the NC in the MDI mode for purposes of parameter reading and writing.

- Select CNC type combo-box
The default CNC model is specified, which is to be assumed when an existing parameter file is opened with the NC not connected (offline).

Name of each part

The name of each part about the Parameter Window is shown.

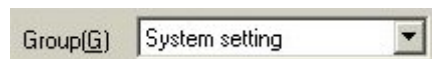


Param - Untitled(ON-LINE:Path2)

: Title bar
 Parameter file name is shown with connection status to CNC and with the target path. Parameter window decides the target path by the axis selection.



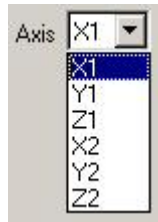
: Servo or Spindle selection
 Basic functional selection about Servo or Spindle



: Functional group selection combo-box
 Major category selection in the functional group (Some group can not be shown by option setting.)



: Functional group selection tab
 Minor category selection in the functional group (Some group can not be shown by option setting.)



- : Axis selection combo-box
Axis selection (Axis name for servo axis and S1, S2, ..., for spindle axis)
In multi-path control system, all axes are shown in numerical order of the path.



- : Hint display checkbox
If the mouse pointer is applied to an item, tool tip hints about parameter number and explanation will be displayed. If you don't want hints, turn off this checkbox.

4.2 EXPLANATION OF THE MENU

The contents of the menu in the Parameter Window are explained.

[File]

- New ([Ctrl]+[N])
Two or more Parameter Windows can be opened simultaneously. If this menu is chosen, another Parameter Window will be shown and a new parameter file can be opened.
- Read ([Ctrl]+[R])
A parameter file is read into the window which is used now. (It becomes OFFLINE mode)

NOTE

This command cannot read a parameter file of a CNC model with a different parameter format. To read parameters of a different CNC model, therefore, use the [New] command.

- Close ([Ctrl]+[C])
The window used now is closed.
- Reload ([Ctrl]+[Q])
The parameters are reload from CNC. If you changed the parameters in offline mode, they are cancelled, and carried out the rereading of parameters on NC.
- Disconnect to CNC ([Ctrl]+[B])
The mode of Parameter Window changes from online to offline.
- Reconnect
This menu is made to restore, when a communication error occurs by a certain reason, while using it in ONLINE mode. (Example: power-off parameters are changed choose this menu after turning off / turning on NC.)
- Save ([Ctrl]+[S])
Save the file with overwriting
- Save As
Save the file with another name. The type of the file is text format. (The default extension is *.prm.)
- Print ([Ctrl]+[P])
This menu can be available only in [Parameter Table] which is in the functional group selection combo-box. This realizes the print like spreadsheet.
- Exit
Exit application.

[Edit]

- FS16 Init (Series 16i only)
Clear all parameters read.
- Read Standard Parameter
The standard parameters for every motor are initialized by the parameter sets which are included in servo software.

[Move]

- Jump to Parameter (Ctrl+G)
This can be used only if [Parameter Table] is chosen in the functional group selection combo-box. It jumps to the place of the specified parameter number.

[Window]

- New Window (Ctrl+W)
Two or more Parameter Windows can be opened with the same parameter set. For example, when tuning the feed-forward coefficient, it is convenient to see the parameter of both the X-axis and the Y-axis at once. This is useful for the purpose.

NOTE

When many parameter windows are opened, resources may become insufficient in Windows 98 and Me, resulting in screen display disorder. Use of Windows 2000 or XP is therefore recommended.

4.3 USAGE

This section explains how to use the Parameter Window.

Using in ONLINE mode

In ONLINE mode, the change of parameter is reflected to NC at the following timing.

- When a spin button is pushed.
- When the [Return] key is pushed after changing the contents in edit box directly.
- When the focus moves to other item after changing the contents in edit box directly.
- When a radio button and a check box are pushed.

The usage of a parameter table display

If you want to change parameters other than the categorized parameter groups, Choose [Parameter Table] in the functional group selection combo-box.

The change of parameter in the table can be also reflected to NC.

- In case of bit type parameter
By single click, 8 bits check box will open as follows. Put a required bit here and push [Return] key.

2	00000000	<-
12	00001000	00000000
20	<input type="checkbox"/> B7:	<-
21	<input type="checkbox"/> B6:	<-
22	<input type="checkbox"/> B5:	<-
23	<input checked="" type="checkbox"/> B3:	<-
24	<input type="checkbox"/> B2:	<-
100	<input type="checkbox"/> B1:	<-
101	<input type="checkbox"/> B0:	<-

- In case of value type parameter
By double click, a parameter becomes editable. Push [Return] key after editing value.

- In case of multi path system
 Path selection tabs are displayed at right bottom of the parameter table screen.
 Right column of parameter number describes array type of the parameter. (A:axis, S:spindle, L:path, T:machine group)

- FS16i

Parameters are treated separately for each path.

1010		3	<-
1012	A	00000000	00000000
1015		00000000	<-
1020	A	88	89
1022	A	1	2
1023	A	1	2
1024	A	0	0

Path1 Path2

- FS30i

Although there is one set of parameters in the entire system, they can be displayed for each path.

1013	A	00000010	00000010
1014	A	00000000	00000000
1015	L	00000000	<-
1020	A	88	89
1022	A	1	2
1023	A	1	2
1024	A	0	0

ALL Path1 Path2

Printing is also supported in the parameter table display. Select [Print] from [File] menu, and specify the parameter number to print in the following dialog box.

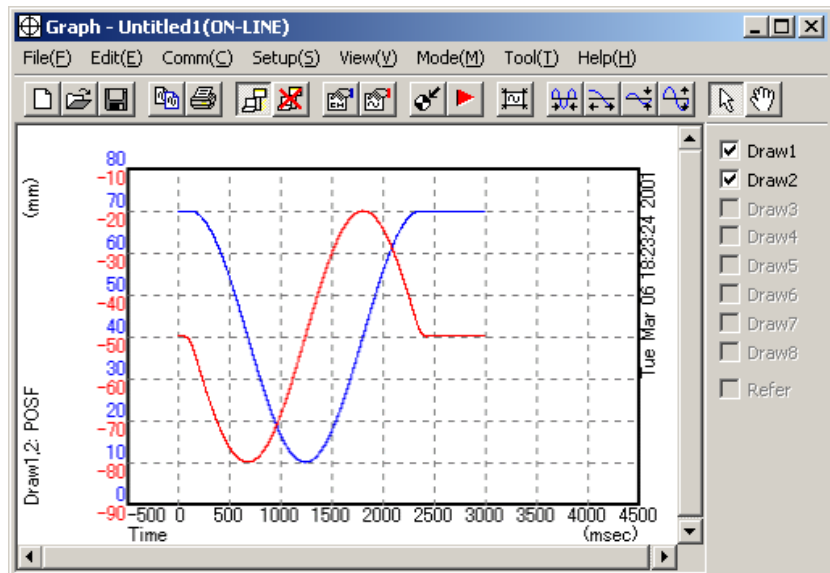
Parameter No. for printing

Start

End

5

GRAPH WINDOW



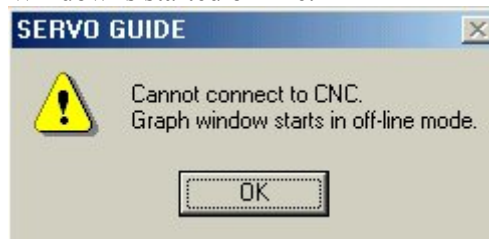
The Graph Window allows use of various drawing modes for acquiring many types of data such as the positions and torque values of servo axes and spindle axes and analyzing measurement data.

The window also allows measurement of velocity loop frequency response and supports determination of linear motor smoothing compensation parameters.

5.1 OVERVIEW

Starting the Graph Window

When you press [Graph] on Main Bar, Graph Window is shown. When the Graph Window is displayed for the first time, an attempt is automatically made to set up a connection to the NC. If the connection to the NC fails, the following message appears, and the Graph Window is started offline.



Waveform display in the Graph Window [Important]

The waveform on Graph Window is shown by the following two data.

Measurement data

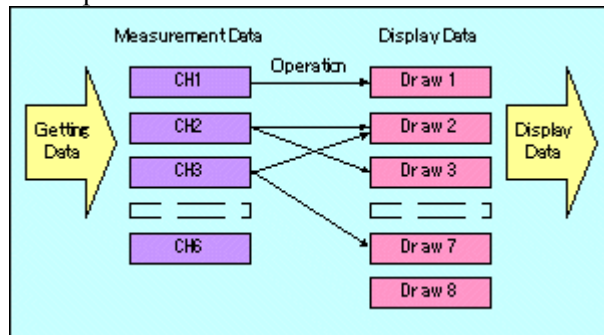
Raw data from NC (Position, Torque, etc.)

NOTE

When raw data is acquired from the NC, the bit width is 16 bits including a sign. On the other hand, SERVO GUIDE treats raw data as 32-bit data by performing advance processing at intervals of the sampling period or 1 ms, whichever shorter. Therefore, data longer than 16 bits such as position feedback data can also be measured. (The advance processing is always performed regardless of the type of measurement data, so perform an origin operation as necessary.)

Operation data

An operation is performed on measurement data to create display data.



Waveform display in the Graph Window (conceptual diagram)

In the following explanation, we use CHANNEL(CH) as Measurement data and DRAW(Draw) as Display data.

CH1 : Measurement data 1

Draw3 : Display data 3

NOTE

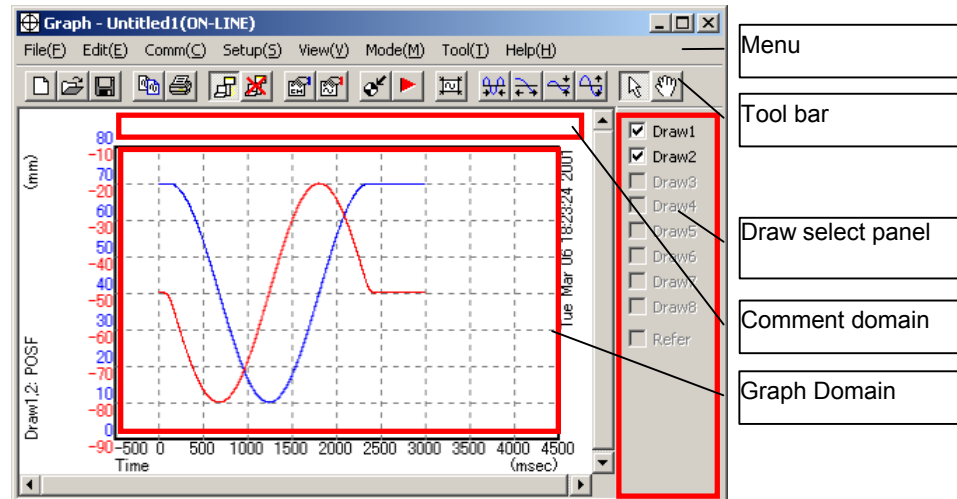
To display a waveform in the Graph Window, operation settings are always required.

If you use maximum ability of Graph Window, you see the 8 DRAW(Draw1-8) by setting eight kinds of operation against 6 CHANNEL(CH1-6).

In particular, in the Y-Time mode, more than one draw can be set for data measured on one channel and they can be displayed at the same time.

Name of each part

The name of each part of the Graph Window is explained below.


Graph domain

The internal domain in bold line is the place where display waveform. The kind of data, operation and unit are shown in the left side of it.

Comment domain

Two line comments are shown above the bold line. When you click the domain, you can edit the comments.

Menu

You can execute some commands by the menu. Refer Section 5.2 "MENU" for details.

Tool bar

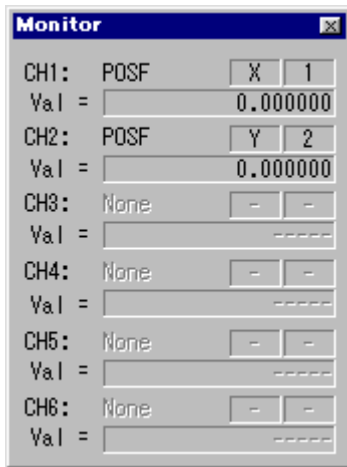
You can execute some commands by click the button. Refer to Section 5.3 "TOOL BAR" for details.

Draw select panel

Switch Display mode valid or invalid. You can use this switch at some Draws where some operations are set.

Example)

The left example shows that the operation 1, 2, 3 are given and the display of Draw 1, 2 are valid and Draw 3 is invalid.

Monitor window

You can use Monitor Window by select menu [Comm]-[Monitor] at ONLINE state.

In the Monitor Window, current data output to each channel can be monitored.

You can monitor the current data of every CHANNEL on this dialog. Every CHANNEL shows the kind of data, axis name, axis number and current data.

The data become gray if the CHANNEL is invalid.

5.2 MENU

The contents of menu of Graph Window are shown.

[File(F)]

- New(N) (Ctrl+N)
Open new window.
- Read(R)
Read stored waveform data.
The files of iTUNE.EXE and SD.EXE can be read.
- Close(C)
Close this window.
- Save(S) (Ctrl+S)
Save the current data
Default file name is brought up from comments or measuring date/time.
- Save As(A)
Save the current data after change the name.
Default file name is brought up from comments or measuring date/time.
It's possible to save the data by CSV format.
- Print Setup(U)
Setting for print out.
- Print(P) (Ctrl+P)
Print out of current waveform.
- Exit(X)
Terminate SERVO GUIDE.
It closes any other windows also.

[Edit(E)]

- Copy(C) (Ctrl+C)
Copy the bitmap of current waveform to clipboard.

[Comm(C)]

- Start (F1)
Start measurement.
- Connect(C)
Connect with NC and transmit the setting for measurement.
- Disconnect(D)
Disconnect with NC and clear the setting for measurement.
- Monitor(M)
Switch Monitor Window (Valid or Invalid).
 - Hide
Monitor Window become invalid.
 - Normal
Monitor Window is shown with normal type.
 - Detail
Monitor Window is shown with detail type.

[Setup(S)]

- Channel (F9)
Show CHANNEL setting dialog.
- Operation (F5)
Show OPERATION setting dialog.
- Load Setting (Alt+1 - Alt+8)
Restore the CHANNEL settings and OPERATION settings which are saved before.
- Save Setting
Save the CHANNEL settings and OPERATION settings.
- Change Scale (F3)
Change scale in Graph Domain.

[View(V)]

- Toolbar(T)
Switch the display of Tool bar.
- Statusbar(S)
Switch the display of Status bar.
- Scrollbar
Switch the display of Scrollbar which is used for change display domain.
- Draw1-8 (Shift+1 - Shift+8)
Switch the display of Draw1-8.
- Reference (Shift+P)
Switch the display of reference waveform.
This is enabled only when the XY display mode is selected.
- Auto Scaling (A)
Execute auto-scale for all Draws.
- H-Zoom in (↑(Up Arrow))
Expand horizontal scale.
- H-Zoom out (↓(Down Arrow))
Shrink horizontal scale.
- V-Zoom in (u, Shift+u)
Expand vertical scale.
- V-Zoom out (d, Shift+d)
Shrink vertical scale.

[Mode(M)]

Selection in Easy Graph Mode.

- XYTYT (Ctrl+T)
Display of position (Horizontal axis means time.)
- VT (Ctrl+V)
Display of velocity (Horizontal axis means time.)
- AT (Ctrl+A)
Display of acceleration (Horizontal axis means time.)
- CIRCLE (Ctrl+B)
Display of contour error of circle
- XY (Ctrl+X)
Display of XY
- XTVT (Ctrl+W)
Display of tangent speed (Horizontal axis means time.)
- DXDY (Ctrl+D)
Display of feed smoothness (Horizontal axis means time.)
- SYNCHRO
Display of synchronous error (Horizontal axis means time.)
- CONTOUR (Ctrl+O)
Display of contour error of arbitrary shape
- NORMAL, POLAR(XYR), ANGULAR(XYA) (Ctrl+R)
Selection of a coordinate conversion mode
(Switching to polar coordinates mode and angular axis mode)
- FOURIER (Ctrl+F)
Display of analysis of vibration

[Tool(T)]

- Frequency Response(F)
 - Measure
Open the dialog for frequency response.
Measurement of velocity loop frequency response
 - Bode plot (Ctrl+M)
Re-draw of bode diagram
- LinearMotorComp.Cal(L) (Ctrl+L)
Show the dialog for calculation of Smoothing compensation with linear motors.

[Help(H)]

- Contents(C)
Show contents of help file.
- Index(I)
Show index of help file.

5.3 TOOL BAR

Tool bar for Graph Window is as following.



tool bar is displayed just below the menu in the upper part of the Graph Window. You can execute some commands by click the buttons.

If you want to switch the display of tool bar, use the menu [View]-[Toolbar].

Number Functions

- <1> Open new window.
- <2> Read stored waveform data.
- <3> Save the current data.
- <4> Copy the bitmap of current waveform to clipboard.
- <5> Print out of current waveform.
- <6> Connect with NC and transmit the setting for measurement.
- <7> Disconnect with NC and clear the setting for measurement.
- <8> Show CHANNEL setting dialog.
- <9> Show OPERATION setting dialog.
- <10> Execute origin.
- <11> Start measurement.
- <12> Execute auto-scale for all Draws.
- <13> Shrink horizontal scale.
- <14> Expand horizontal scale.
- <15> Shrink vertical scale.
- <16> Expand vertical scale.
- <17> Select Draw.
- <18> You can change view point.


5.4 USAGE


Using with ONLINE

To measure through graph window, channel setting and calculation setting are necessary.

Connection

It is possible to keep some graph windows open on screen, but only one window is able to communicate with NC.

To connect a certain Graph Window to the NC, select [Comm] in the menu then [Connect], or press connection button  in the tool bar.

When the Graph Window has been connected to the NC, and channel setting has been performed normally, measurement button  becomes effective.

Channel setting

Select the data of the servo axis or spindle axis for which a measurement is to be made. Data on up to six channels can be measured at the same time.

For details, see Section 5.6.

Operations setting

Settings for displaying measured data are made. Up to eight waveforms can be displayed at the same time.

For details, see Section 5.7.

Easy Graph Mode

Operation settings often used for displaying measured data can be made at a time by using the easy graph mode.

For details of the easy graph mode, see Section 5.9.

Using with OFFLINE

There is no limit in particular except for measuring data through CNC.

It is possible to load BIN file got by SD.EXE. (It is necessary to set channel setting for detection of data series.)

(SD.EXE is the soft on MS-DOS that analyzes the data on servo axis.)

5.5 SHORTCUT

Easy Graph Mode

By using the following short cut, you can handle some display settings in the same way as SD.EXE. Keyboard operation is as common operation as possible to SD.EXE.

(SD.EXE is the soft on MS-DOS that analyzes the data on servo axis.)

Short cut	Setting mode
[Ctrl] + [T]	Position mode (time base)
[Ctrl] + [V]	Velocity mode (time base)
[Ctrl] + [A]	Acceleration mode (time base)
[Ctrl] + [J]	Jerk mode (time base)
[Ctrl] + [B]	Error mode of circle
[Ctrl] + [X]	XY mode
[Ctrl] + [W]	Tangent velocity mode (time base)
[Ctrl] + [D]	Smoothness at moving (time base)
[Ctrl] + [O]	Shape error mode
[Ctrl] + [R]	Coordinate conversion (polar coordinates and angular axis) switching
[Ctrl] + [F]	Frequency analysis mode(Fourier transform)
[Ctrl] + [M]	Bode plot

Chanel setting, calculation and display setting

Short cut	Function
[F9]	Load channel setting mode.
[F5]	Load calculation and display mode.
[F3]	Load scale setting mode.
[Alt] + [1], ... , [Alt] + [8]	Channel setting. Restore scale setting.

Measuring data

Short cut	Function
[F1]	Start data measurement.
[o]	Set origin.

Scale setting

Short cut	Function
[u], [Shift] + [u]	Zoom up on position axis.
[d], [Shift] + [d]	Zoom down on position axis.
[↑]	Zoom up on time axis.
[↓]	Zoom down on time axis.
[a]	Scale setting automatically.

File operation


Short cut	Function
[Ctrl] + [N]	Open new window.
[Ctrl] + [S]	Save waveform.
[Ctrl] + [P]	Print waveform.
[Ctrl] + [C]	Copy waveform to clipboard.

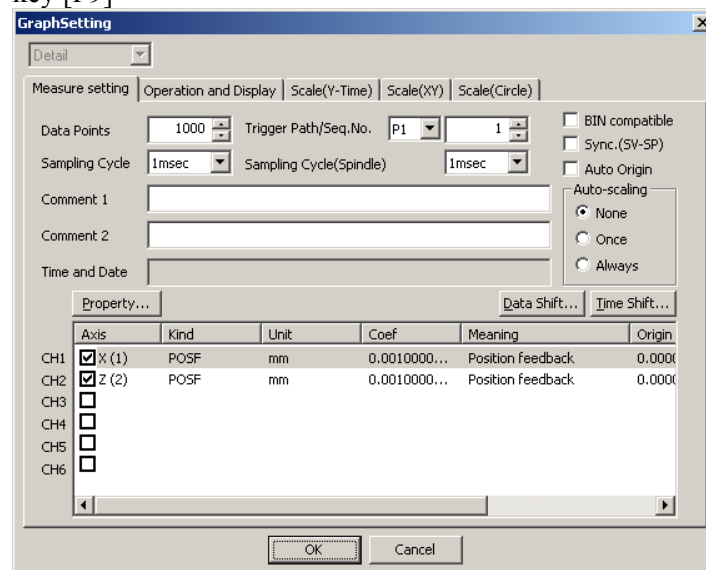
Others

Short cut	Function
[Ctrl] + [L]	Open Smoothing compensation dialog.

5.6 CHANNEL SETTING

5.6.1 Procedure

To show the channel setting mode, click channel operation button  on toolbar or select the [Channel] on [Setting(S)] menu of Graph Window. It is possible to show channel operation mode with short cut key [F9]



In this page, you can set the necessary items to measure the data. The setting items are as follows:

- Number of measurement data points
- Trigger setting (path, N number)
- Sampling period
- Comment
- Measurement data in each channel (Measurement axis, the kind of measurement data, operation coefficient, unit)

Number of measurement data points :

You can set the number of measurement data points.

Measurement time =

The number of measurement data points × sampling period

The maximum of the number of data points are 100000. When you watch the contour error about arbitrary shape, set the number of data points as small as possible to make the calculation time short.

If you set the different sampling period between servo and spindle, the numbers of measurement data points are applied to shorter one. The number of longer one must be decreased according to the ratio of sampling period.

NC sends the data to PC with buffering. In the case of buffer overflow for high-speed sampling, the number of measuring points become lower than setting one.

Trigger path :

You can select the path number where program runs. If you select blank, the first path is selected automatically.

Trigger sequential number (N number) :

You can set trigger condition that is the start point of getting data in running program. If you set the Nxxx number in program and set xxx as trigger sequential number, then getting the data starts from Nxxx block in the program. If you set 0, getting data starts immediately without waiting for trigger signal.

In the case you use trigger function, set N-number for trigger before the program line which make the servo motor move fast. If the motor moves fast among the waiting trigger, the position may be incorrect.

See Subsection 5.12.3 “Limitation of Measurement” for details.

Sampling period :

You can set sampling period between servo and spindle individually. If the sampling period for servo axes and the sampling period for spindle axes are different from each other, linear interpolation is performed for the data obtained with the longer sampling period. (One sampling period must be an integral multiple of the other sampling period; setting sampling periods of 2 ms and 5 ms, therefore, is not permitted.) When data that is updated at long intervals (such as position data) is measured at high speed, a discrepancy due to the difference in update timing may occur.

- For servo axes, 62.5 μ s, 125 μ s, 250 μ s, 500 μ s, 1 ms, 2 ms, 5 ms, 10 ms, 20 ms, 50 ms, or 100 ms may be selected. Depending on the selected sampling period, the number of channels is limited; for example, only one channel can be measured per DSP when 62.5 μ s is selected; up to two channels can be measured when 125 μ s is selected; and up to four channels can be measured when 250 μ s is selected. Furthermore, because of limitations in the NC, up to two channels can be measured in the entire NC when 62.5 μ s is selected, and up to four channels can be measured in the entire NC when 125 μ s is selected.
- For spindle axes, 500 μ s, 1 ms, 2 ms, 5 ms, 10 ms, 20 ms, 50 ms, or 100 ms is selected if the spindle is an α i spindle (bit 7 of GDN No. 400 is set to 1). If the spindle is an α spindle, the sampling period can be set to 8 ms only.

Comment 1, 2 :

You can make the comment on data. This function is used as a memo for example measurement content, parameter condition and etc. When you click the comment domain upper graph windows, you can edit the comment.

Time and Data :

Time and data of measurement data (Read Only)

5.6.2 Available Data at Servo Axes

Measurable data table on servo axis is displayed.
(For data marked †, high-speed sampling is possible.)

Symbol	Meaning of measurement data Setting of conversion coefficient	Remarks
POSF	Integral value of position feedback Set moving distance per 1 pulse (Detection unit).	
VCMD	Velocity command Set 3750min^{-1} .	
TCMD†	Torque command Set maximum current value (Ap) of using amplifier.	
SPEED	Real speed (Motor speed) Set 3750min^{-1} .	
ERR	Position error Set moving distance per 1 pulse (Detection unit).	
SYNC	Synchronous error on rigid tapping (only tapping axis) Set 1. (It means 4096 pulses per 1 rotation.)	
ABS†	Absolute position (2^{21} p/rev) detected internal pulse coder Set moving pulse per 1 revolution.	
DTRQ	Estimated disturbance value Set maximum current value (Ap) of using amplifier.	
DLTCM	Difference of torque between simple synchronous axes Set maximum current value (Ap) of using amplifier. When you use this as the parameter setting for Torque Difference Alarm Level, set 1 both at conversion coefficient and conversion level.	
SFERR	Semi-full error on dual position feedback Set moving distance per 1 pulse (Detection unit).	
BLCMP	Backlash compensation Set moving distance per 1 pulse (Detection unit).	
BLAC1	Backlash acceleration (1st stage acceleration) Set 1. (It means internal value in servo software.)	
BLAC2	2nd stage backlash acceleration Set 1. (It means internal value in servo software.)	
ROTOR†	Phase angle of rotor Set 360deg.	
SIN_T†	sin(rotor phase) Set 1. (This has no dimension.)	
FREQ†	Disturbance input frequency (It is useful for measurement of frequency characteristic.) Set 1. (Hz)	
FRTCM†	Disturbance input torque (It is useful for measurement of frequency characteristic.) Set maximum current value (Ap) of using amplifier like torque command.	
OVCLV	OVC simulation data Set 1. It occurs OVC alarm when the value becomes 100%.	
ERRC	Position error (including delay of FAD) Set moving distance per 1 pulse (Detection unit).	
IR†	R-phase current Set maximum current value (Ap) of using amplifier.	
IS†	S-phase current Set maximum current value (Ap) of using amplifier.	

Symbol	Meaning of measurement data Setting of conversion coefficient	Remarks
IEFF	Actual current Set maximum current value (Ap) of using amplifier.	
IQ†	Active current Set maximum current value (Ap) of using amplifier.	
ID†	Reactive current Set maximum current value (Ap) of using amplifier.	
ERMON	Position error for monitoring (Parts Learning Control) Set moving distance per 1 pulse (Detection unit).	90D3 only
S2ST4	Status flag (Parts Learning Control)	90D3 only
SVPOS	Rotational motor position This data is valid for αi servo motor.	90B1/02 or later (plan)
MTTMP	Motor winding temperature (°C) This data is valid for αi servo motor.	90B1/02 or later (plan)
PCTMP	Pulsecoder temperature (°C) Set 1. This data is valid for αi servo motor.	90B1/02 or later (plan)
RPLIN	Smoothness compensation (Linear) Set maximum current value (Ap) of using amplifier.	90B1/02 or later (plan)

S2ST4 (Parts learning status signal)

#15	#14	#13	#12	#11	#10	#9	#8
PARTLS	ERROVR	ERRCHK					
#7	#6	#5	#4	#3	#2	#1	#0

PARTLS : 1 = Parts learning control in progress

ERROVR : 1 = An error exceeds a specified range during parts learning control.

ERRCHK : 1 = Error monitoring is currently performed during parts learning control.

5.6.3 Available Data at Spindle Axes

The measurable data table on spindle axes is shown.

Because of the communication capacity, the number of channels for spindle axes is smaller than that of servo axes.

Details of measurement data are summarized elsewhere.

α i spindle

Series and editions of applicable system software

[SYSTEM]

B0H1/05, B1H1/06 BDH1/05, BEH1/06, DDH1/05, DEH1/06 or later

[ETHERNET]

656A/03 or later

[SPINDLE]

9D50/02, 9D53/01, 9D70/01 or later

The number of channel is 2 that is the maximum number when sampling period is 1ms , and 1 channel when sampling period is 500 μ sec.

Symbol	Meaning of measurement data Setting of conversion coefficient	Remarks
SPEED	Motor speed (4096 = 1 min ⁻¹)	
INORM	Amplitude of motor current	
TCMD	Torque command (16384 = maximum Motor torque 100%)	
VCMD	Motor speed command (4096 = 1 min ⁻¹)	
VERR	Velocity error (4096 = 1 min ⁻¹)	
MCMD	Motion command per communication period (Cs mode: 360000 or 3600000 p/rev, other: 4096 p/rev)	
ERR	Position error (Cs mode: 360000 or 3600000 p/rev, other: 4096 p/rev)	9D50/11 or later ^{*1}
ERRC	Position error (CNC) (Cs mode: 360000 or 3600000 p/rev, other: 4096 p/rev)	
SYNC	Synchronous error (4096 p/rev)	9D50/11 or later ^{*1}
ORERR	Position error at orientation (2 ²⁴ p/rev)	
ORSEQ	Orientation sequence data	
PCPOS	Integration of position feedback (2 ²⁴ p/rev)	
CSPOS	Integration of position feedback (360000 or 3600000 p/rev)	
WMDAT	Motion command per position loop (2 ²⁴ p/rev)	

Symbol	Meaning of measurement data Setting of conversion coefficient	Remarks
ERR2	Position error 2 (2^{24} p/rev)	
ERR2C	Position error 2 (CNC) (2^{24} p/rev)	9D50/11 or later ^{*1}
SPCMD	Velocity command data from CNC (16384 = motor maximum speed (No.4020))	
SPSPD	Spindle speed (4096 = 1min^{-1})	9D50/11 or later ^{*1}
SPCT1	Spindle Control Signal 1	
SPCT2	Spindle Control Signal 2	
SPCT3	Spindle Control Signal 3	9D50/11 or later ^{*1}
SPST1	Spindle Status Signal 1	
SPST2	Spindle Status Signal 2	
SFLG1	Spindle flag 1	9D50/11 or later ^{*1}
SPPOS	Spindle position data	9D50/13 or later ^{*2}
LMDAT	Load meter data (32768 = load meter voltage 10V)	9D50/11 or later ^{*1}
DTRQ	Spindle load torque (Unexpected disturbance torque detection function) (16384 = maximum Motor torque 100%)	9D50/11 or later ^{*1}
FREQ	Frequency of disturbance torque (Disturbance input function)	9D50/11 or later ^{*1}
GAIN	Gain data (Disturbance input function) (4096 = 100%)	9D50/11 or later ^{*1}
MTTMP	Motor winding temperature (degrees centigrade)	9D50/11 or later ^{*1}
MFBDF	Motor sensor feedback incremental data (For amplitude ratio and phase difference compensation)	9D50/11 or later ^{*1}
SFBDF	Spindle sensor feedback incremental data (For amplitude ratio and phase difference compensation)	9D50/11 or later ^{*1}
PA1	AD data of A phase of motor sensor	9D50/11 or later ^{*1}
PB1	AD data of B phase of motor sensor	9D50/11 or later ^{*1}
PA2	AD data of A phase of spindle sensor	9D50/11 or later ^{*1}
PB2	AD data of B phase of spindle sensor	9D50/11 or later ^{*1}
VDC	DC link voltage 200V SPM: 4096=100V 400V SPM: 4096=170V	9D50/11 or later ^{*1}
SFERR	Semi-full error (Dual position feedback) (2^{24} p/rev)	9D50/11 or later ^{*1}
SMERR	Semi-closed side error (Dual position feedback) (2^{24} p/rev)	9D50/11 or later ^{*1}

*1) 9D53 series: 9D53/03 or later, 9D70 series: 9D70/02 or later

*2) 9D53 series: 9D53/04 or later, 9D70 series: 9D70/03 or later

α spindle

The number of channel that you can set is only 1, and sampling period is 8msec.

Symbol	Meaning of measurement data Setting of conversion coefficient	Remarks
PCPOS	Integral value of position feedback from position coder. (16384p/rev)	9D20/11 or later
CSPOS	Integral value of position feedback at Cs contour control. (360000 p/rev or 3600000 p/rev) In the case that parameter No.4005#0 is 1 , the value is 3600000 p/rev. Note) When motor speed is below the value, [the maximum speed at Cs contour control mode \times gear ratio + 50] (min^{-1}) integration is calculated actually. If the speed become over the value, integral calculation is stopped.	9D20/11 or later

Details about spindle data

Descriptions about measurable data for αi spindle.

Data for current and velocity control

SPEED (Motor speed, $4096 = 1 \text{ min}^{-1}$)

Actual motor speed.

Maximum resolution of this data is " $4096 = 1 \text{ min}^{-1}$ " at shift value="0".

In default setting, shift value is "-12" and the resolution is " $1 = 1 \text{ min}^{-1}$ ".

INORM (Amplitude of motor current)

Amplitude of actual motor current.

Set Conv. Coef. and Conv. Base according to following procedure to convert the unit to "Ap".

Unit : Select A(p).

Conv Coef. : Set $640 \times Ga \div ICNV$.

Conv. Base : Set 1024.

ICNV (current conversion constant) :

Setting of parameter No. 4110 (Low speed winding : parameter No. 4146)

Ga (current detecting gain) :

Coefficient for SPM model. See following table.

SPM	SPM(HV)	Ga
SPM-2.2 <i>i</i>	SPM-5.5HV <i>i</i>	16.67
SPM-5.5 <i>i</i>	SPM-11HV <i>i</i>	
SPM-11 <i>i</i>	SPM-15HV <i>i</i>	33.33
SPM-15 <i>i</i>	SPM-30HV <i>i</i>	50.00
SPM-22 <i>i</i>	SPM-45HV <i>i</i>	66.67
SPM-26 <i>i</i>	—	100.00
SPM-30 <i>i</i>	SPM-75HV <i>i</i>	133.33
SPM-37 <i>i</i>		
SPM-45 <i>i</i>	SPM-100HV <i>i</i>	150.00
SPM-55 <i>i</i>	—	233.33

TCMD (Torque command, $16384 = 100\%$)

"16384(100%)" is maximum torque command.

VCMD (Velocity command, $4096=1 \text{ min}^{-1}$)

Velocity command for actual motor speed control.

Maximum resolution of this data is " $4096 = 1 \text{ min}^{-1}$ " at shift value="0".

In default setting, shift value is "-12" and the resolution is " $1 = 1 \text{ min}^{-1}$ ".

VERR (Velocity error, 4096=1min⁻¹)

Difference data between velocity command and actual motor speed (VCMD-SPEED).

Maximum resolution of this data is "4096 = 1 min⁻¹" at shift value="0".

In default setting, shift value is "-12" and the resolution is "1 = 1 min⁻¹".

SPCMD (Velocity command data from CNC, 16384=Maximum motor speed)

Velocity command data from CNC on velocity control mode (spindle control mode).

16384=Maximum motor speed setting of parameter No. 4020

Set Conv. Coef = setting of parameter No. 4020 and Conv. Base = 16384 to convert the unit to "min⁻¹".

SPSPD (Spindle speed, 4096=1min⁻¹)

Actual spindle speed.

Maximum resolution of this data is "4096 = 1 min⁻¹" at shift value="0".

In default setting, shift value is "-12" and the resolution is "1 = 1 min⁻¹".

Arbitrary gear ratio (parameter No. 4171 to No.4174) should be set correctly in case of semi-closed system.

Data for position control**MCMD (Motion command per communication period, 360000 or 3600000^(*)p/rev or 4096p/rev)**

Motion command transferred from CNC every communication period.

Cs contouring mode : 360000p/rev or 3600000p/rev *

Other modes (Spindle synchronous mode, Rigid tapping mode) : 4096p/rev

(*) In case of IS-C setting.

ERR (Position error, 360000 or 3600000^(*)p/rev or 4096p/rev)

Position error displayed on DGN No.714 (FAD position error).

This data does not contain the error due to FAD smoothing.

Cs contouring mode : 360000p/rev or 3600000p/rev *

Rigid tapping mode, Spindle synchronization mode : 4096p/rev

(*) In case parameter No. 4005#0 is set to "1".

ERRC (Position error (CNC), 360000 or 3600000^(*)p/rev or 4096p/rev)

Position error displayed on DGN No.418 (regular position error).

This data contains the error due to FAD smoothing.

Cs contouring mode : 360000p/rev or 3600000p/rev *

Other modes (Spindle synchronization mode, Rigid tapping mode) : 4096p/rev

(*) In case parameter No. 4005#0 is set to "1".

SYNC (Synchronous error, 4096 p/rev)

Synchronous error on rigid taping and spindle synchronization.

Rigid tapping : Difference between spindle position error and servo axis position error.

Spindle synchronization: Absolute value of position error difference between 1st spindle and 2nd spindle.

parameter No. 3700#7 should be set to "1" to measure this data. (This function is for maintenance of FS16i/18i/21i. You must set this parameter to "0" after use this function.)

ORER (Position error at orientation, 2^{24} p/rev)

Positional deviation used for position control at the time of orientation.

Maximum resolution of this data is " 2^{24} p/rev" at shift value="0". In default setting, shift value is "-10" and the resolution is "16384 p/rev (360 deg)".

ORSEQ (Orientation sequence data)

This data indicates the status during spindle orientation.

You can check the status (orientation start, acc./dec. state, position loop close, ..etc.) during orientation mode.

See following tables for relation of ORSEQ and control state.

High speed orientation

ORSEQ	Control state
0 → 1	Orientation command ON (ORCM = 0 → 1)
1	Acceleration/deceleration to orientation speed. Preparing for position control.
1 → 3	Close position loop.
3	Deceleration according to Parameter No. 4320 - No. 4323.
3 → 7	Transition to positioning by position gain.
7	Positioning by position gain.
7 → 0	Completion of orientation (ORAR = 0 → 1)

Normal orientation

ORSEQ	Control state
0 → 2	Orientation command ON (ORCM = 0 → 1)
2	Acceleration/deceleration to orientation speed. Preparing for position control.
2 → 6	Close position loop.
6	Positioning by position gain.
6 → 0	Completion of orientation (ORAR = 0 → 1)

PCPOS (Integration of position feedback, 2^{24} p/rev)

Integration data of position feedback indicating the distance from origin point.

Maximum resolution of this data is " 2^{24} p/rev" at shift value="0". In default setting, shift value is "-10" and the resolution is "16384p/rev (360deg)".

Arbitrary gear ratio (parameter No. 4171 to No. 4174) should be set correctly in case of semi-closed system.

CSPOS (Integration of position feedback, 360000 or 3600000^(*)p/rev)
Integration data of position feedback indicating the distance from origin point.

Arbitrary gear ratio (parameter No. 4171 to No.4174) should be set correctly in semi-closed system.

(*) In case parameter No. 4005#0 is set to "1".

WMDAT (Motion command per position loop, 2²⁴p/rev)

Motion command for actual position control.

Maximum resolution of this data is "2²⁴ p/rev" at shift value="0".

In default setting, shift value is "-10" and the resolution is "16384p/rev (360deg)".

ERR2 (Position error 2, 2²⁴ p/rev)

Position error for internal control loop. (Cs contouring mode, Rigid tapping mode)

This data does not contain the error due to FAD smoothing.

Maximum resolution of this data is "2²⁴ p/rev" at shift value="0".

In default setting, shift value is "-10" and the resolution is "16384 p/rev (360deg)".

ERR2C (Position error 2 (CNC), 2²⁴ p/rev)

Position error for motion command from CNC. (Cs contouring, Rigid tapping, Spindle synchronization)

This data contains the error due to FAD smoothing.

Maximum resolution of this data is "2²⁴ p/rev" at shift value="0".

In default setting, shift value is "-10" and the resolution is "16384p/rev (360deg)".

SFERR (Semi-full error, 2²⁴ p/rev)

Difference data between full-closed side error and semi-closed side error (ERR1-SMERR) of dual position feedback function.

Maximum resolution of this data is "2²⁴ p/rev" at shift value="0".

In default setting, shift value is "-10" and the resolution is "16384p/rev (360deg)".

SMERR (Position error of semi-closed side, 2²⁴ p/rev)

Semi-closed side position error of dual position feedback function.

Maximum resolution of this data is "2²⁴ p/rev" at shift value="0".

In default setting, shift value is "-10" and the resolution is "16384p/rev (360deg)".

Spindle control signal and Spindle status signal

See following tables for configurations of Spindle control signals and Spindle status signals.

For details about each signals refer to "FANUC AC SPINDLE MOTOR α i series/ β i series PARAMETER MANUAL (B-65280EN)"

SPCT1 (Spindle control signal 1)

#15	#14	#13	#12	#11	#10	#9	#8
RCH	RSL	INTG	SOCN	MCFN	SPSL	*ESP	ARST
#7	#6	#5	#4	#3	#2	#1	#0
MRDY	ORCM	SFR	SRV	CTH1	CTH2	TLMH	TLML

SPCT2 (Spindle control signal 2)

#15	#14	#13	#12	#11	#10	#9	#8
			DSCN	SORSL	MPOF		
#7	#6	#5	#4	#3	#2	#1	#0
RCHHG	MFNHG	INCMD	OVR	DEFMD	NRRO	ROTA	INDX

SPCT3 (Spindle control signal 3)

SPCT2 (Spindle control signal 2)

#15	#14	#13	#12	#11	#10	#9	#8
#7	#6	#5	#4	#3	#2	#1	#0

SPST1 (Spindle control signal 1)

#15	#14	#13	#12	#11	#10	#9	#8
				RCFN	RCHP	CFIN	CHP
#7	#6	#5	#4	#3	#2	#1	#0
ORAR	TLM	LDT2	LDT1	SAR	SDT	SST	ALM

SPST2 (Spindle control signal 2)

#15	#14	#13	#12	#11	#10	#9	#8
			CSPEN				
#7	#6	#5	#4	#3	#2	#1	#0
			EXOF	SOREN		INCST	PC1DT

Other data

SFLG1 (Spindle flag 1)

Frequently used PMC signals and internal flags are included in this data.

See following table for configuration of this data.

For details about PMC signals refer to "FANUC AC SPINDLE MOTOR α i series/ β i series PARAMETER MANUAL (B-65280EN)"

#15	#14	#13	#12	#11	#10	#9	#8
			TCSAT				TRNSNT
#7	#6	#5	#4	#3	#2	#1	#0
ORAR	ORCM	SFR	SRV	SAR	SDT	SST	FGRD

(*1) FGRD (1 rev. signal detecting flag) :

Internal flag indicating that if this flag is set to 1, a one-rotation signal is generated

(*2) TRNSNT(Transient state flag (acc./dec. state)) :

Internal flag indicating that if this flag is set to 1, the transient state (acceleration/deceleration is in progress) is present.

(*3) TCSAT (Torque command saturation flag) :

Internal flag indicating that if this flag is set to 1, the torque command is saturated.

SPPOS (Spindle position data, 2^{24} p/rev)

Spindle position data from 1-rotation signal.

Maximum resolution of this data is " 2^{24} p/rev" at shift value="0".
In default setting, shift value is "-12" and the resolution is "4096p/rev".

You should set shift amount between "-15" and "-10".

Arbitrary gear ratio (parameter No. 4171 to No. 4174) should be set correctly in case of semi-closed system.

LMDAT (Load meter data, 32768 = 10V)

This data is equivalent to load meter voltage output from LM terminal(JY1) of SPM.

32768(10V)=Maximum motor output (about 1.2 times of short time rated power).

When you convert this data equivalent to load meter display value on CNC screen,

Set Conv. Coef = setting of parameter No. 4127 (Low speed winding : No. 4093) and Conv. Base = 32768.

DTRQ (Spindle load torque, 16384 = maximum Motor torque 100%)

Estimated spindle load torque for "Unexpected Disturbance torque Detection Function"

16384(100%) = Maximum motor torque.(about 1.2 times of short time rated torque)

For data output, the option of the unexpected disturbance torque detection function is required.

FREQ (Frequency of disturbance torque, Hz)

Frequency of disturbance torque command of disturbance input function.

GAIN (Gain data, 4096=100%)

Gain data of disturbance input function. You can measure frequency response of velocity loop and seek out resonance point.

Frequency at gain data = 70% is cut-off line (-3dB) of velocity loop.

For details about disturbance input function, refer to "FANUC AC SPINDLE MOTOR αi series/ βi series PARAMETER MANUAL (B-65280EN)"

MTTMP (Motor winding temperature, °C)

Motor winding temperature data displayed on DGN No.403.

Resolution of this data is 1 °C.

MFBD (Incremental data of motor feedback)

Incremental data of motor sensor feedback (connected to JYA2). You can use this data for adjusting amplitude ratio and phase difference compensation.

65536 is equivalent to 1 λ of BZi sensor.

Set Conv. Coef = $(360/\lambda)$ and Conv. Base = 65536 to convert the unit to "deg."

In default setting, Conv. Coef. is set to "1.40625" for 256 λ BZi sensor.

Adjust parameter Nos. 4355 and 4356 to minimize the variation width of this data while in the velocity control mode, turning the motor at a motor speed of $4685/\lambda$ [min^{-1}] by specifying a velocity command.

For details about this function, refer to "FANUC AC SPINDLE MOTOR αi series/ βi series PARAMETER MANUAL (B-65280EN)"

SFBDF (Incremental data of spindle feedback)

Incremental data of spindle sensor feedback (connected to JYA4).

You can use this data for adjusting amplitude ratio and phase difference compensation.

65536 is equivalent to 1λ of BZi sensor.

Set Conv. Coef = $(360/\lambda)$ and Conv. Base = 65536 to convert the unit to "deg."

In default setting, Conv. Coef. is set to "1.40625" for 256λ BZi sensor.

Adjust parameter Nos. 4357 and 4358 to minimize the variation width of this data while in the velocity control mode, turning the motor at a motor speed of $4685/\lambda$ [min^{-1}] by specifying a velocity command.

For details about this function, refer to "FANUC AC SPINDLE MOTOR α i series/ β i series PARAMETER MANUAL (B-65280EN)"

PA1/PB1 (AD data of motor sensor A phase/B phase, 65536=1.48V)

AD conversion data of motor sensor A phase/B phase (connected to SPM JYA2).

You can measure amplitude and offset at mounting BZi sensor.

When you measure these data, the motor speed should be under $3072/\lambda$ [min^{-1}]. (λ : teeth number of BZi sensor gear)

PA2/PB2 (AD data of spindle sensor A phase/B phase, 65536=1.48V)

AD conversion data of spindle sensor A phase/B phase (connected to SPM JYA4).

You can measure amplitude and offset at mounting BZi sensor.

When you measure these data, the spindle speed should be under $3072/\lambda \text{ min}^{-1}$. (λ : teeth number of BZi sensor gear)

For details about regulations refer to "MAINTENANCE MANUAL (B-65285EN)"

NOTE

When you measure PAx/PBx by SERVO GUIDE, regulation of offset data (Voffs) is not $2.5\text{V} \pm 100\text{mV}$ (described in MAINTENANCE MANUAL) but $0\text{V} \pm 100\text{mV}$.

VDC (DC link voltage, 4096=100V or 170V)

AD conversion data of DC link voltage.

200V SPM : 4096=100V

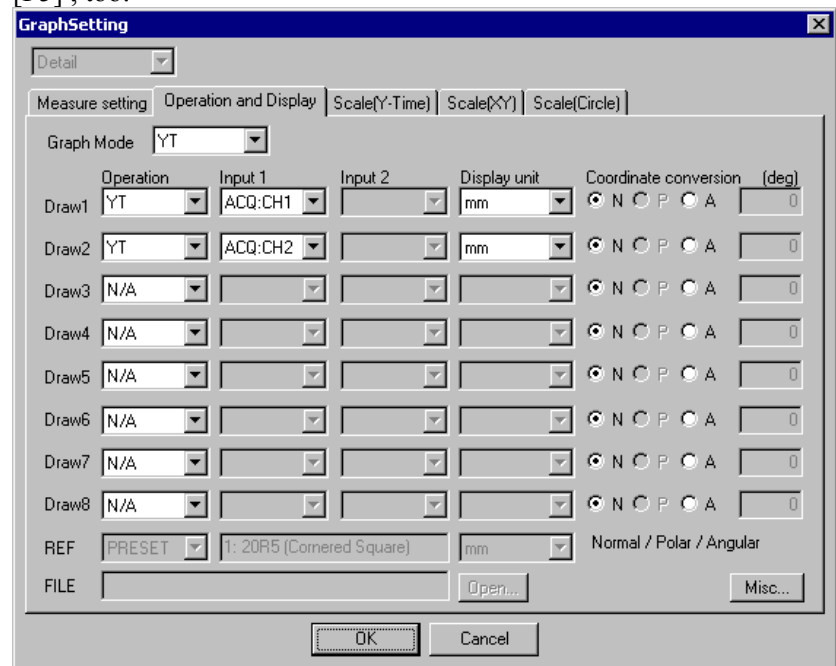
400V SPM (HV) : 4096=170V

5.7 OPERATION SETTING

5.7.1 Procedure

Operation of calculation mode for waveform display is shown by the following method.

Click the operation of calculation button on toolbar, select [calculation display] on [operation] menu in graph window or click shortcut key [F5], too.



On this page, necessary items for waveform display are set. The following items are set:

- Selection of a basic graph mode
- Selection of an operation for each Draw
- Selection of input (measurement data) for each Draw
- Selection of the display unit of each Draw
- Setting of a coordinate conversion to be applied to each Draw (if necessary)
- Setting of a reference waveform for contour comparison (if necessary)

5.7.2 Basic Graph Mode

Selection of Basic Graph Mode

Select Basic Graph Mode among following three.

Y-Time mode

This mode shows the data like oscilloscope which shows time as horizontal axis and value as vertical axis.

This mode has most various kinds of operations for data analysis.

XY mode

This mode shows the XY display made by two channels which is selected from all channels.

The CONTOUR mode, which shows the contour error of arbitrary program path, is included in this mode.

Circle mode

This mode shows the contour error of circle path.

The parameters for reference circle should be set at the dialog for scale change.

We prepare some sheets to set the scale for every Basic Graph Mode.

Scale setting (Y-Time) : The scale setting for YT mode

Scale setting (XY) : The scale setting for XY mode and CONTOUR mode

Scale setting (Circle) : The setting for circle mode

You can change the scale by above sheets. You can use the auto-scale, the expansion and the shrink by keyboard operations also.

Special graph modes

You can't set the operations for the following special mode. Use the exclusive menu of Graph Window.

- Vibration frequency (Fourier Mode)
- Frequency response (Bode)

5.7.3 Available Operations

When you select "Basic Graph mode", the operation list you can select will be shown according to Basic Graph Mode.

The followings are all operations.

YT mode (The horizontal axis shows Time.)

Operations	Contents
YT	No operation ((Data on a selected channel is displayed directly without operation)The vertical axis shows the amount of "Input1". You can select the data of all channels. When you use polar coordinates conversion, set radius to "Input1" and angle to "Input2". $R \cdot \cos(\theta)$ will be shown at Draw1,3,5,7. $R \cdot \sin(\theta)$ will be shown at Draw2,4,6,8. When performing angular axis conversion, set a Cartesian axis in "Input1" and an angular axis in "Input2".
Diff1(VT)	1st order differential data of position will be shown. (It means velocity.) The vertical axis shows the amount of "Input1". This can be available only against the channel which get position data. Polar coordinates conversion and angular axis conversion are disabled.
Diff2(AT)	2nd order differential data of position will be shown. (It means acceleration.) The vertical axis shows the amount of "Input1". This can be available only against the channel which get position data. Polar coordinates conversion and angular axis conversion are disabled.
Diff3(JT)	3rd order differential data of position will be shown. (It means jerk.) The vertical axis shows the amount of "Input1". This can be available only against the channel which get position data. Polar coordinates conversion and angular axis conversion are disabled.
Tangent	Tangent speed display. This can be available only against the channel which get position data. The composite speed of "Input1" and "Input2" is displayed. When using polar coordinates conversion, set a radius in "Input1" and an angle in "Input2". When using angular axis conversion, set a Cartesian axis in "Input1" and an angular axis in "Input2". When coordinate conversion is set, a composite speed is calculated for the position data obtained after coordinate conversion.
Tangent N	N-axes tangent speed display This can be available only against the channel which get position data. The composite speed of position data from a channel specified in "Input1" to a channel specified in "Input2" is displayed. The data on all the target channels for composition must be position data. Polar coordinates conversion and angular axis conversion are disabled.
Smooth	The smoothness of feed will be shown. This can be available only against the channel which get position data. It means the deviation from ideal path which is calculated by the supposition of constant speed from the start point to end point.
Synchro	The synchronous error will be shown. This can be available only against the channel which get position data. It means the difference between "Input1" and "Input2". We suppose that the feedback ratio between them is 1:1 so far.
Bit	Bit indication A specified bit of raw data of a channel specified in "Input1" is extracted. Select the bit to be extracted in "Input2". This operation is used to measure flags such as the spindle control signal. To prevent missing digits, the conversion coefficient and conversion base for channel setting must be both set to 1.

XY mode

Operations	Contents
XY	<p>XY display will be shown. The horizontal axis shows "Input1" and the vertical axis shows "Input2". When using polar coordinates conversion, set a radius in "Input1" and an angle in "Input2". When using angular axis conversion, set a Cartesian axis in "Input1" and an angular axis in "Input2".</p>
Contour	<p>XY contour error will be shown. The horizontal axis shows "Input1" and the vertical axis shows "Input2". When using polar coordinates conversion, set a radius in "Input1" and an angle in "Input2". When using angular axis conversion, set a Cartesian axis in "Input1" and an angular axis in "Input2". It's necessary to set Reference data to calculate the error.</p>

CIRCLE mode

Operations	Contents
Circle	<p>Circle contour error will be shown. The horizontal axis shows "Input1" and the vertical axis shows "Input2". When using polar coordinates conversion, set a radius in "Input1" and an angle in "Input2". When using angular axis conversion, set a Cartesian axis in "Input1" and an angular axis in "Input2". Set the circle radius at the dialog of scale setting to determine the reference circle.</p>

Setting of coordinates conversion

Polar coordinates conversion (XYR)

This is used for measuring polar coordinate interpolation data.
 Rotation axis data (in degrees) is always required for measurement data.

Angular axis conversion (XYA)

This is used for measuring angular axis control data.

Setting of input channels

For "Input1" and "Input2" in the list, channels that can be selected depending on the operation are set. If there is no channel to select, the color becomes gray.

5.7.4 Setting of Unit

Some available units are shown in the combo-list according to the kind of data and operation you select.

If you want to use the polar conversion, you have to measure the position data of one rotary axis at least. (You have to select "deg" as the unit.)

5.7.5 Load Reference Path

When you select XY mode on basic graph mode , you can load reference path.

There are the following four choices as reference path.

- (1) Preset path 1 (20R5) "PRESET"
- (2) Preset path 2 (40R5) "PRESET"
- (3) Loading files "FILE"
- (4) Loading from program window "CUSTOM"

Preset path

These are the reference paths prepared beforehand. There are two kinds of square which have 1/4 arc at every corner.

Preset path 1 is program path drawn in the default condition of "Square with 1/4 arc".

Preset path 2 is program path drawn in the default condition of "Cs contouring control".

File

Reference waveform is loaded from file. The necessary file format is CSV format (plane text divided by commas).

0.000,10.000
1.000,10.000

Program window

You can use program path drawn by program window.

5.8 SCALE SETTING

5.8.1 Overview

The display domain of the graph window can be set directly on the page of scale setting.

The setting page is divided by the base graph mode.

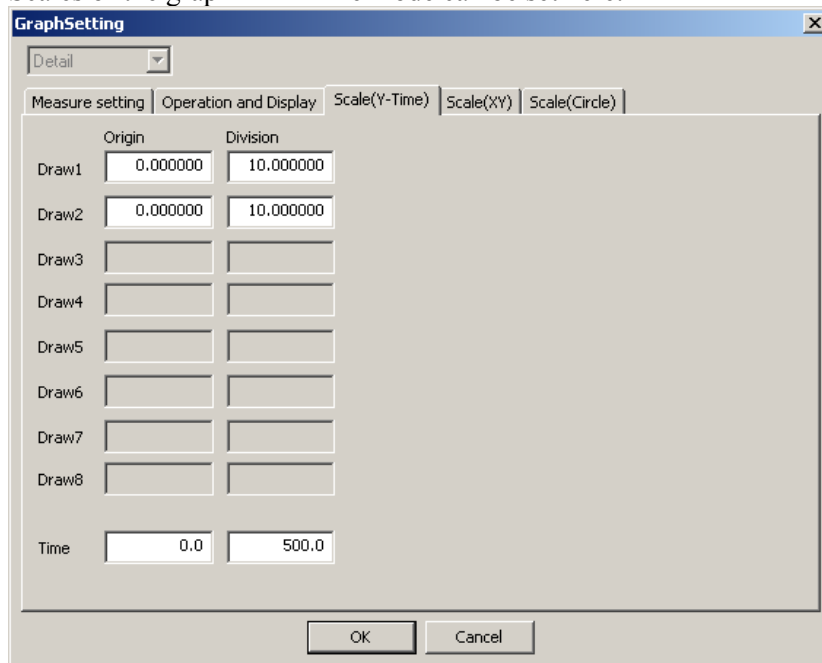
- Scale setting (Y-Time)
- Scale setting (XY)
- Scale setting (Circle)

When special graph mode is selected, following special setting page can be displayed.

- Scale setting (Fourier)
- Scale setting (Bode)

5.8.2 Scale (Y-Time)

Scales of the graph in Y-Time mode can be set here.



Origin:

Set the center coordinates of display data (Draw 1..8: vertical axis).

Set the starting time of display data (Time: horizontal axis).

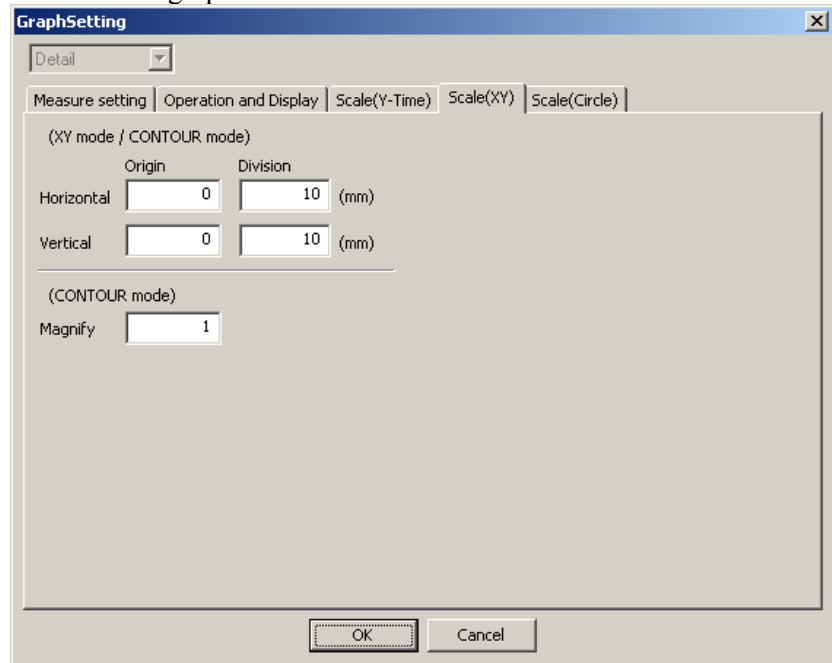
Division:

Set the value per one grid of display data (Draw 1..8: vertical axis).

Set the time per one grid of display data (Time: horizontal axis).

5.8.3 Scale (XY)

Scales of the graph in XY mode can be set here.



Origin (horizontal, vertical):

Set the center coordinates of display data.

Division(horizontal, vertical):

Set the value per one grid of display data.

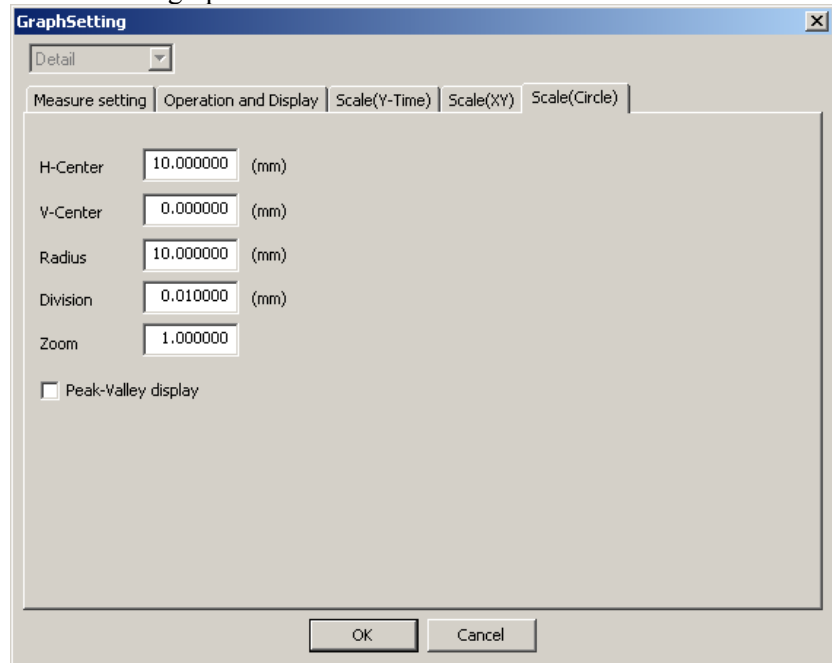
Magnify:

Set the multiple ratio of the contour error (control deviation on a XY path) in CONTOUR mode.

A scale setting in XY mode is common to all Draws.

5.8.4 Scale (Circle)

Scales of the graph in CIRCLE mode can be set here.



Center point (horizontal):

Set the abscissa (horizontal coordinates) of the center of the circle.

Center point (vertical):

Set the ordinate (vertical coordinates) of the center of the circle.

Radius:

Set the radius of the circle.

Division :

Set the scale of the circle display. An expansion of a display by [u] key and shrink by [d] key are also available in graph display.

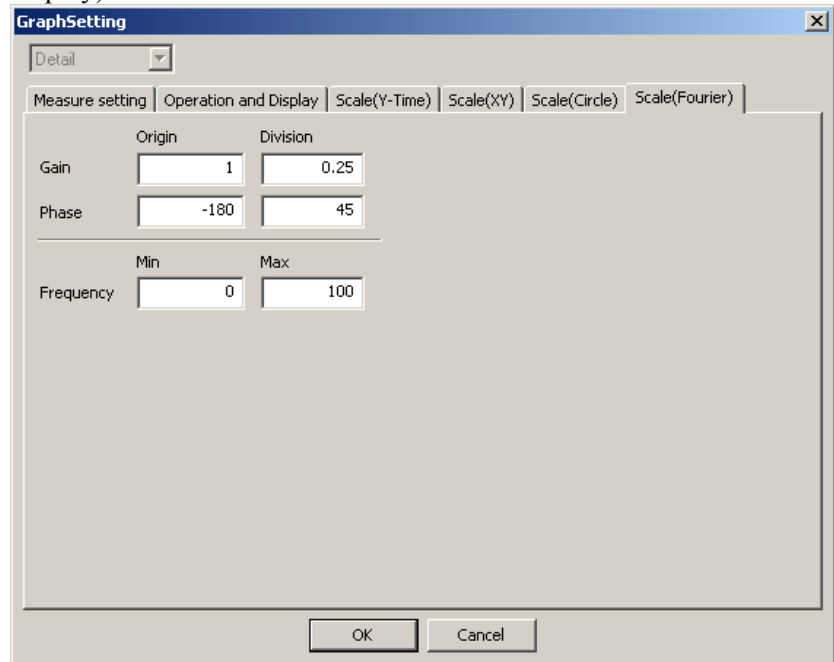
Zoom :

Set the multiple ratio for expansion against the central angle at the point of quadrant change. It is effective at watching the details of a quadrant protrusion. Usually, use it as 1.0.

An expansion of a display by [z] key and reduction by [shift + z] key are also available in graph display.

5.8.5 Scale (Fourier)

Scales of the graph in FOURIER mode (vibration frequency analysis display) can be set here.



Origin (horizontal, vertical):

Set the values of center in Gain-diagram and Phase-diagram.

Division (horizontal, vertical):

Set the value per one grid of display data.

Frequency:

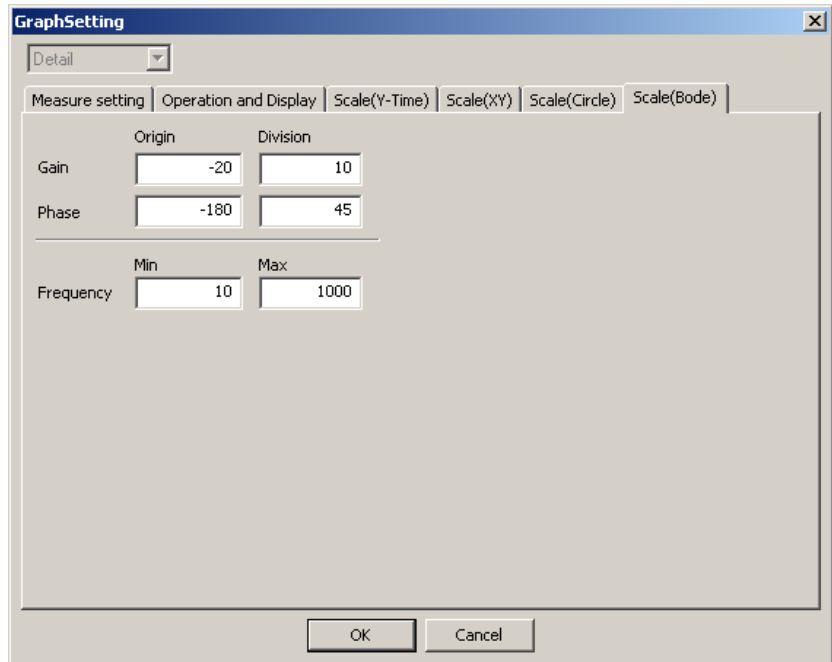
Set the minimum value and maximum value of a horizontal axis. The unit is not necessarily 1=1Hz, because it depends on the time range chosen in Y-Time mode.

Example)

The unit of frequency is equivalent to 1= 10Hz when the time range for 0.1 seconds is chosen.

5.8.6 Scale (Bode)

Scales of the graph in BODE mode (frequency response display) can be set here.



Origin:

Set the values of center in Gain-diagram and Phase-diagram.

Division:

Set the values per one grid of Gain-diagram and Phase-diagram.

Frequency:

Set the minimum value and maximum value of a horizontal axis.

The unit of frequency is Hz.

5.9 EASY GRAPH MODE

We prepared the setting way to change the operations which must be often used in SERVO GUIDE Graph Window. We call it "Easy Graph Mode". You can use it from menu or shortcut.

List of Easy Graph Mode

Mode	Explanation
XTYT mode [Ctrl] + [T]	Raw data will be shown. (The horizontal axis means time.) The data of all channels will be shown.
VT mode [Ctrl] + [V]	Velocity display (The horizontal axis means time.) The 1st order differential will be done against the position data of measurement channel. It means velocity. (The differential is not done against the data except position. So VCMD, TCMD and etc are shown as raw data.)
AT mode [Ctrl] + [A]	Acceleration display (The horizontal axis means time.) The 2nd order differential will be done against the position data of measurement channel. It means acceleration. (The differential is not done against the data except position. So VCMD, TCMD and etc are shown as raw data.)
CIRCLE mode [Ctrl] + [B]	Circle error display The contour error of circle will be shown. The horizontal axis means CH1 and the vertical axis means CH2. The reference circle should be set at the dialog of scale setting.
XY mode [Ctrl] + [X]	XY display The XY path will be shown. The horizontal axis means CH1 and the vertical axis means CH2.
XTVT mode [Ctrl] + [W]	Tangent velocity display (The horizontal axis means time.) Draw1 shows the position of CH1. Draw2 shows the tangent velocity made by CH1 and CH2.
DXDY mode [Ctrl] + [D]	The smoothness of moving will be shown. (The horizontal axis means time.) The smoothness of moving against the measurement channel will be shown. (This operation is not done against the data except position. So VCMD, TCMD and etc are shown as raw data.)
CONTOUR mode [Ctrl] + [O]	The contour error will be shown. The contour error between the reference path and the XY path made by CH1 and CH2 will be shown.
POLAR(XYR) mode [Ctrl] + [R]	Polar coordinates conversion mode Use this for the conversion from the movement by one rotary axis and one straight axis to two straight axes. We suppose CH1 is straight axis and CH2 is rotary axis in Easy Graph mode. This can be used with XTYT mode, CIRCLE mode, XY mode and CONTOUR mode.
ANGULAR(XYA) mode [Ctrl] + [R]	Angular axis conversion mode Use this for the conversion from the movement by angular axis to perpendicular axis. We suppose CH1 is perpendicular axis and CH2 is angular axis in Easy Graph mode. This can be used with XTYT mode, CIRCLE mode, XY mode and CONTOUR mode.

Mode	Explanation
NORMAL mode [Ctrl] + [R]	Cancellation of coordinate conversion mode The POLAR mode and ANGULAR mode are canceled.
FOURIER mode [Ctrl] + [F]	Frequency analysis (FOURIER conversion) The data, which are calculated by Fourier conversion against the display data of all channels will be shown.

- * This Easy Graph Mode realize the similar shortcut handling as SD.EXE.
(SD.EXE is the soft on MS-DOS that analyzes the data on servo axis.)

NOTE

FOURIER mode can be used only in Easy Graph Mode.

5.10 SPECIAL GRAPH DISPLAY MODES

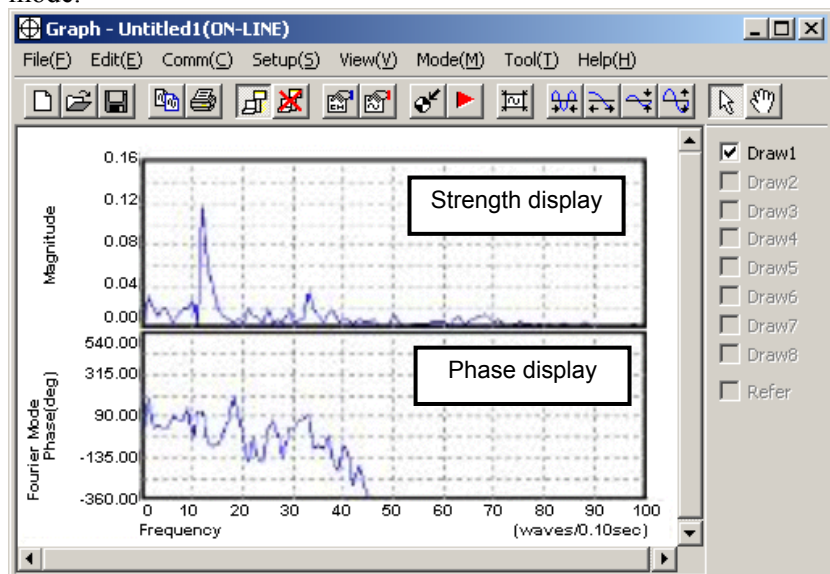
5.10.1 Frequency Analysis (Fourier Transformation) Display Mode

Overview

This mode displays the vibration frequency of measurement data. Fourier transformation is performed for waveform data ranging from the start time (start point) and end time (end point) in the Y-Time mode, and frequency components in strength and phase are displayed.

Display procedure

In any Y-Time mode, display the target waveform for vibration analysis, and select a time domain so that just the part to be analyzed is displayed. Select [FOURIER] in the [Mode (M)] menu of the Graph Window, or press [Ctrl]+[F] to enter the frequency analysis display mode.



NOTE

- 1 The weight of frequency for horizontal axis will be changed according to the time domain you select. Example: If the display range is 0.1 second, the unit is $1/0.1 = 10$ Hz.
- 2 When you display the result of frequency analysis, you can't save the data to a file. In this case, return to the Y-Time mode and after that save it.
- 3 The log scale display can't be available for horizontal axis.

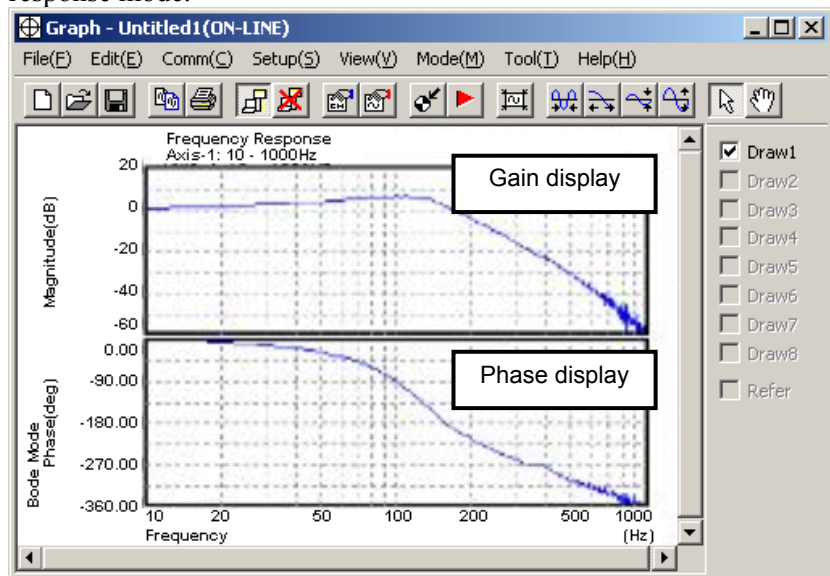
5.10.2 Frequency Response (Bode Diagram) Display Mode

Overview

This mode is used to display the velocity loop frequency response (Bode diagram) of a servo axis that can be measured by the frequency response tool of the Graph Window (see Subsection 5.11.1).

Procedure

From [Frequency Response] in the [Mode (M)] menu of the Graph Window, select [Bode plot] or press [Ctrl]+[M] to enter the frequency response mode.



NOTE

- 1 The frequency response display mode can be entered only when the frequency response is measured with the frequency response tool of the Graph Window or Tuning Navigator.
- 2 It is not allowed to change the horizontal axis of the frequency response display to other than the logarithmic scale display.
- 3 Frequency response display for spindle axes is not supported. To display the frequency response of a spindle axis, use the X-Y mode.

5.11 TOOL

5.11.1 Frequency Response

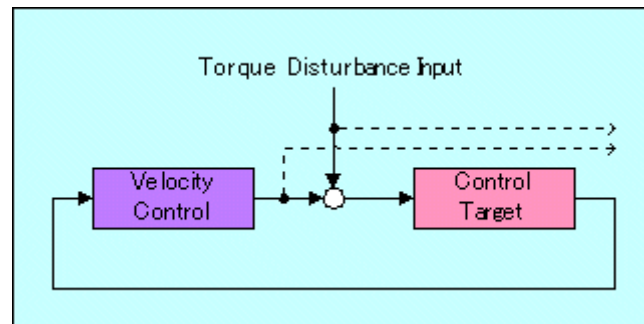
Overview

You can get the frequency response of velocity loop. And you can see the result by Bode diagram.

Mechanism

The servo software generates the SIN wave disturbance by itself. And it is input to TCMD with changing the frequency.

It makes the vibrations against the target machine. We can know the frequency response by the SIN input disturbance and the output of the velocity controller (TCMD).



NOTE

This tool does not support the measurement of the frequency response of spindle axes. For the measurement of the frequency response of a spindle axis, see "CONCRETE EXAMPLES".

Measurement way

Do the following way.

- (1) Select menu [Tool(T)] -> [Frequency Response(F)]->[Measure...]. You can see the dialog for "Frequency Response Measurement".
- (2) If you select the axis to measure frequency response and press the <Measure...> button, this software makes vibrations to target axis of machine automatically , and you can see the frequency response.
- (3) If you press the <Detail> button, you can set the optional setting. Set if you need.
- (4) In case that you want to draw the Bode diagram again, select menu [Tool(T)] -> [Frequency Response(F)] -> [Draw Bode diagram].
- (5) The options you can set at [Detail] are as follows.

Item	Description
Sweep method	<p>SWEPT SIN : The method is adopted in servo software series 9090. (However, you can use this method in series 90B0.</p> <p>Single sweep : The method is adopted in servo software series 90B0.</p> <p>(The way is selected by servo software series automatically, you don't need change the way.)</p>
Sweep frequency	<p>Set the maximum and minimum value of frequency to measure. According to sampling theory, frequency of target is bigger than half frequency of sampling. If you set larger value than the frequency, the aliasing can be seen in the measurement data. Be careful this point when you set the maximum frequency,</p> <p>Series 9096 : Sampling time is 1msec. So maximum frequency is 500Hz.</p> <p>Series 90B0 : Sampling time is 250μsec. So maximum frequency is 2kHz.</p> <p>* The upper fixed value in each series is adopted as sampling time.</p> <p>(Default : from 10 to 1000Hz)</p>
Amplitude of Input	<p>This parameter is amplitude (of one side) when we suppose the maximum current of amplifier means 7282. When the backlash of the target machine is big, it may be necessary to make the amplitude larger.</p> <p>If you make this value too big, OVC alarm may occur. Be careful.</p> <p>(Default : 1000)</p>
Others	<p>To expand the excess error level at the stop</p> <p>: The excess alarm may occur if your error threshold is small, because this measurement is realized by input of torque disturbance.</p> <p>If you check this option, only when you measure the frequency response, the excess error level at the stop will become 32767.</p> <p>Position gain is set to 1</p> <p>: To prevent position loop effect, position gain will become 1 when you measure frequency response of velocity loop.</p> <p>Disable proportional gain down on stop</p> <p>: When you measure the frequency response, this option makes gain down function disable.</p> <p>Disable unexpected disturbance torque detection function</p> <p>: Unexpected disturbance torque detection function doesn't work by SIN wave disturbance.</p>

Limitations

- From SERVO GUIDE 2.0 or later, you can save waveform data to file even if Bode diagram is displayed.
- You can see the data only with the log scale display as horizontal axis.

5.11.2 Smooth Compensation Setting Support

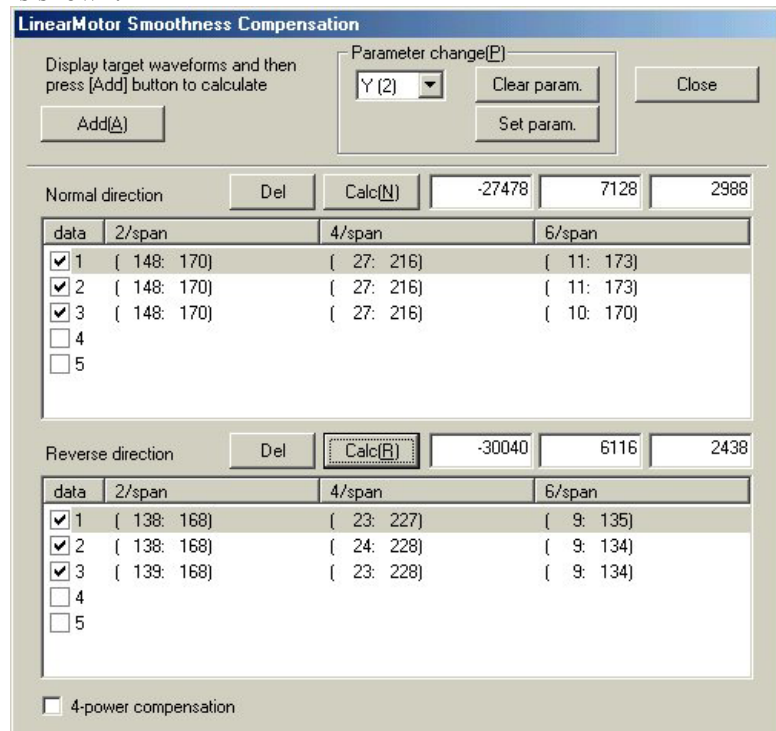
Overview

There is a function to support the setting of "Smooth compensation" with using linear motors.

NOTE

If you use the Synchronous Built-in Servo Motor (what is called "DD motor"), parameter setting No.2207#1=1 enables the smoothness compensation function same as in the linear motors. (SERVO GUIDE 3.00 or later)

After you measure the ROTOR and TCMD data in Graph window, select [Linear Motor Comp. Cal] in [Tool] menu. The following dialog is shown.



You can get the parameters to do the "Smooth compensation" only by pressing <Add> and <Calc> button. You can send the parameters by press <Set param> also.

5.12 SUPPLEMENTARY INFORMATION

5.12.1 Measurement Data Value Scaling

Function explanation

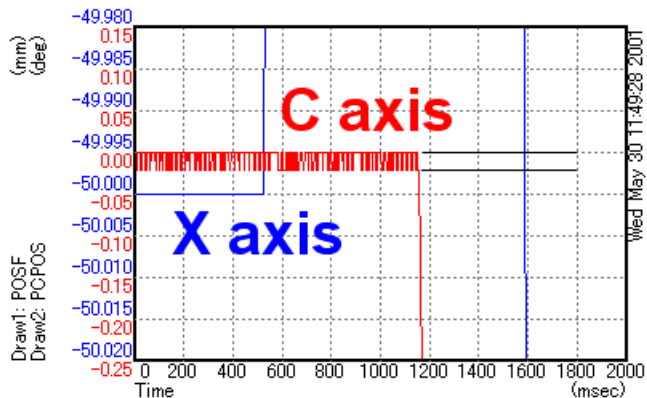
Offset value can be added to measurement data for each channel.

In the normal measurement, the initial value (usually it is 0) is timely set by "origin operation" before measurement, but even if the initial value shifts improperly by some reason, measurement data can be compensated by using this function.

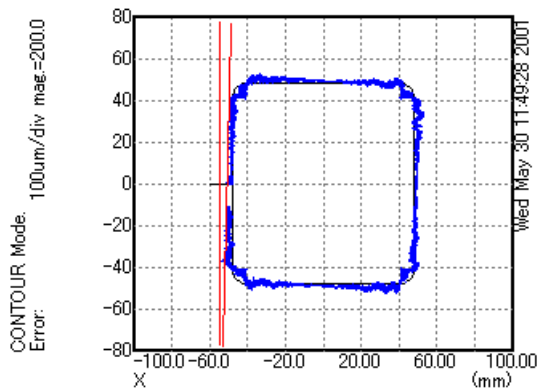
Example

When performing polar-coordinates conversion, the initial value at the time of "origin operation" is very important.

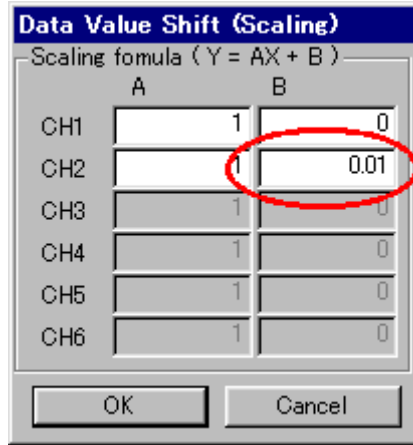
1. A lower figure means the error expansion display of XY path when the initial value of the axis of rotation shifts about -0.01degrees. It is found that XY path leans in the direction of clockwise.



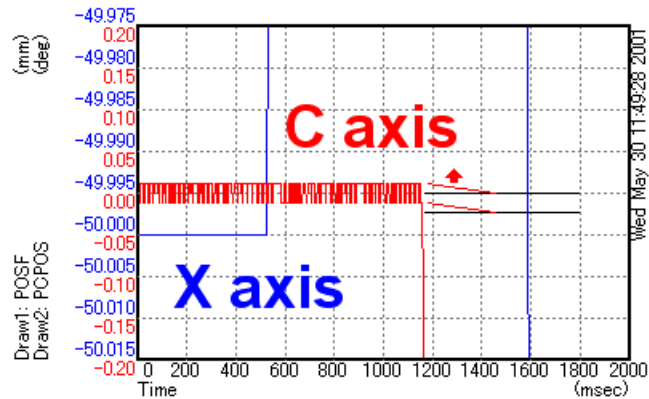
↓ Display of path error



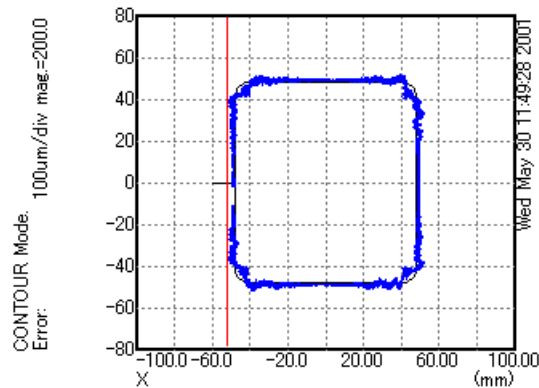
- Here, add offset value to the measurement data of the axis of rotation. (You can access the following dialog from Channel Setting dialog.)



- As a result of adding offset value, it is found that XY path does not lean in the error expansion display as follows.



Display of path error



5.12.2 Measurement Data Time Shift

Function explanation

Data time of measurement data for each channel can be shifted.

When two or more data items whose update periods differ from each other are measured, time synchronization of measured data may fail because of the relationship between the sampling period and internal data update timing, and so forth. Use of this function allows measurement data on individual channels to be displayed by shifting the data in time.

In addition, in case it shifts in time, extrapolation is performed to the time domain where measurement data is not exist.

(The dialog box for time shift setting can be opened from the channel setting page.)

The sign of time-shift means as follows.

+ (plus)

Time delay for measurement data

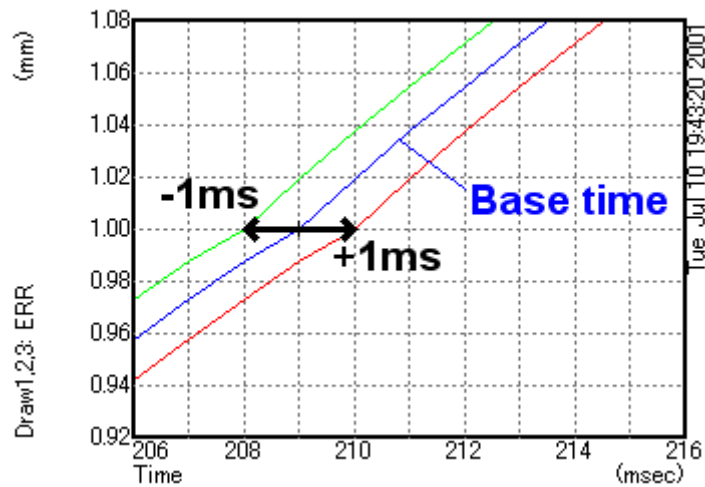
- (minus)

Time lead for measurement data

Setting example

When the data with a certain same axis is measured by three channels, three waveforms overlap to one if not using time shift function, and if time shift sets up as follows, the waveform shifts by order 1msec on the basis of the central waveform as follows is displayed.

Channel	Time Shift (msec)
CH1	0
CH2	1
CH3	-1
CH4	0
CH5	0
CH6	0



5.12.3 Limitation of Measurement

(1) Feedrate which can be measured

Changes within 16000 position detection units per 1ms can be followed up. (This is equivalent to 960m/min for 1 μ m detection unit, and 96m/min for 0.1 μ m detection unit)

If the above feedrate is not exceeded, servo positions during the use of ordinary software are all captured. If the above feedrate is exceeded, however, the position cannot be advanced normally, which can result in deviation of read coordinates from the actual position.

If the set sampling period is longer than 1 ms (such as 10 ms or 100 ms), the software internally acquires data at sampling intervals of 1 ms, and the position is advanced every millisecond, so the feedrate that can be measured mentioned above does not lower.

(2) Note for using triggered measurement

While waiting for trigger, continuation data transmission as normal measurement can not be carried, and position data is advanced by the repetition of single communication between PC and CNC. Because the communication takes about 100ms or longer time, high-speed movement during waiting for trigger may cause the mistake of position data reading. In such a case, make measurement settings so that a trigger occurs before the execution of a program that performs a high-speed movement.

5.12.4 Difference from SD.EXE

The major differences from SD.EXE are as follows:

(SD.EXE is the soft on MS-DOS that analyzes the data on servo axis.)

(1) Architecture

(a) Change of a data acquisition system

Servo check board is not used but the data acquisition system using internal buffer RAM of NC is adopted.

The time synchronization of measurement data is maintained in principle.

The data of a spindle can also be measured.

The number of the maximum measurement channels is increasing (Max. 6CH).

(b) Change of a trigger system

It has changed into the trigger by N number in a NC program instead of the trigger by coordinates.

However, a possibility that position data will shift if it is made to move at high-speed while waiting for trigger.

(2) Measurement data display

(a) Change of measurement data operation processing

Measurement data and display data are separated.

The result which added separate operation to the same measurement data can be simultaneously displayed now.

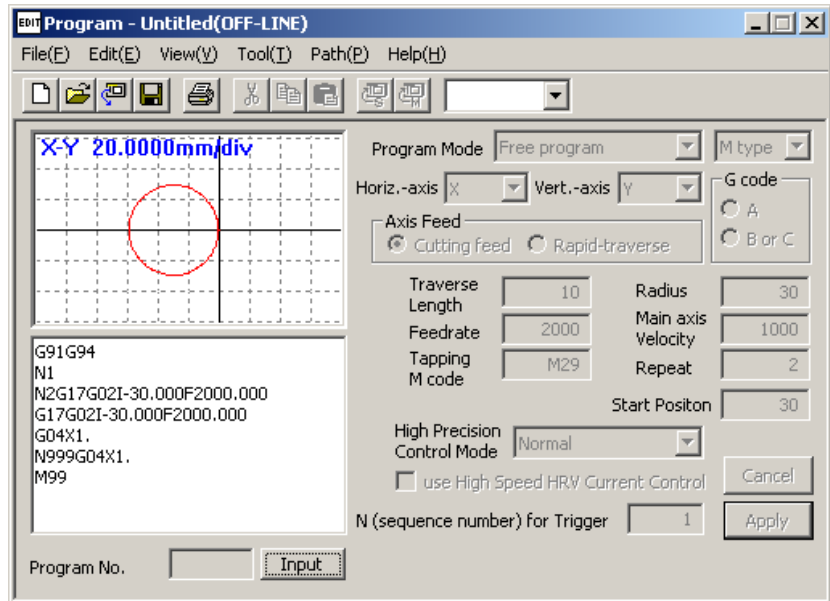
This enables flexible selection of a waveform to be displayed in the Y-Time mode in particular.

(b) Change of vibration frequency display

Gain and phase are displayed separately.

6

PROGRAM WINDOW



The Program Window supports the creation of a test program used for tuning.

Programs such as a program for a square with rounded corners can be created easily.

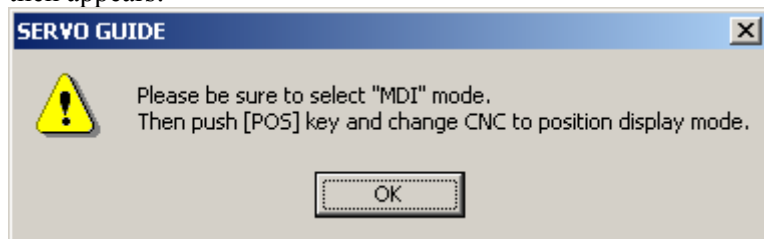
When the Program Window is connected to the NC, a program created in the Program Window can be transferred to the NC for execution.

* The operator must press the cycle start button of the machine.

6.1 OVERVIEW

Starting the Program Window

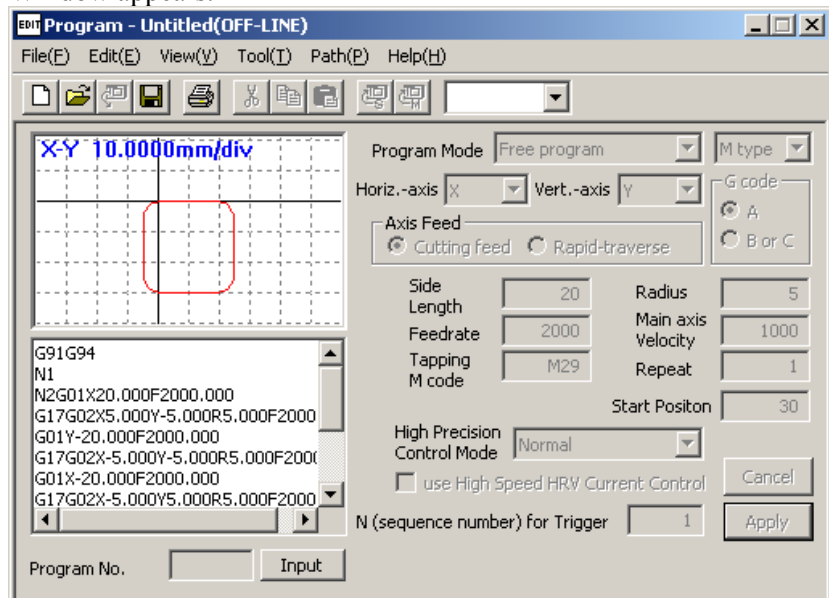
Press the <Program> button on the Main Bar. The following message then appears:



NOTE

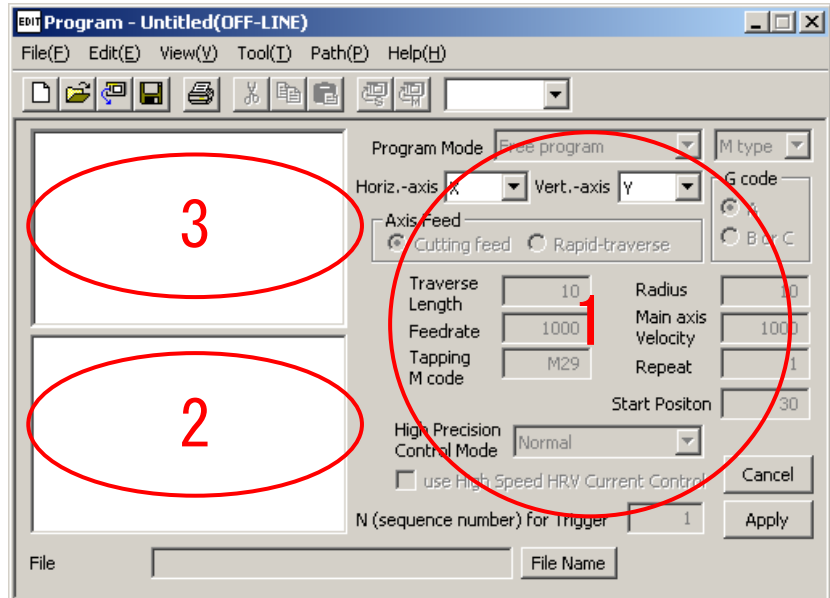
Use the NC in the MDI mode so that parameters and programs can be read and written.
On the NC, display a screen other than the program screen.
(If the NC is in the background edit state, programs cannot be written.)

After confirming the message, press <OK>. Then, the Program Window appears.



Name of each part

The name of each part in the Program Window is explained below.



- <1> program condition setting
- <2> Program text: This box is called "Program edit box". You can edit directly the program in the box.
- <3> Program path

The program made in program window is transmitted to NC's main memory for programs. Then the program is run to call Sub-program from Main-program on MDI memory.

This process is shown to the following.

1. The first process is to set the program conditions and press the <Apply> button.
The test program called "Sub-program" is made.
2. Pressing the [Sub-program transmission], "Sub-program" is transmitted to NC.
3. Pressing the [Main-program transmission], the program whose function is to load the Sub-program is transmitted to MDI's memory.
4. Pressing the [Cycle start] button, the program starts.

NOTE

HPCC, AIHPCC and AINanoHPCC can't be executed by sub-program call like above in the past. But we revised it in the following CNC software editions. You can use them as same as other High speed & High precision modes.

(Supported NC software)

FS16*i*-MB : B0H1-20 or later, B0HA-01 or later

FS16*i*-TB : B1H1-20 or later, B1HA-01 or later

FS18*i*-MB : BDH1-20 or later, BDHA-01 or later

FS18*i*-TB : BEH1-20 or later, BEHA-01 or later

FS18*i*-MB5 : BDH5-10 or later

NOTE

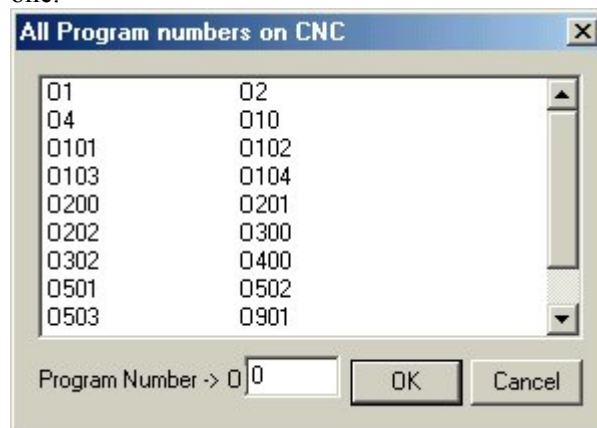
When sub-program transmission is done at the time of the FS30*i* connection, a sub-program is transmitted to the folder of //CNC_MEM/USER/LIBRARY/.

6.2 MENU

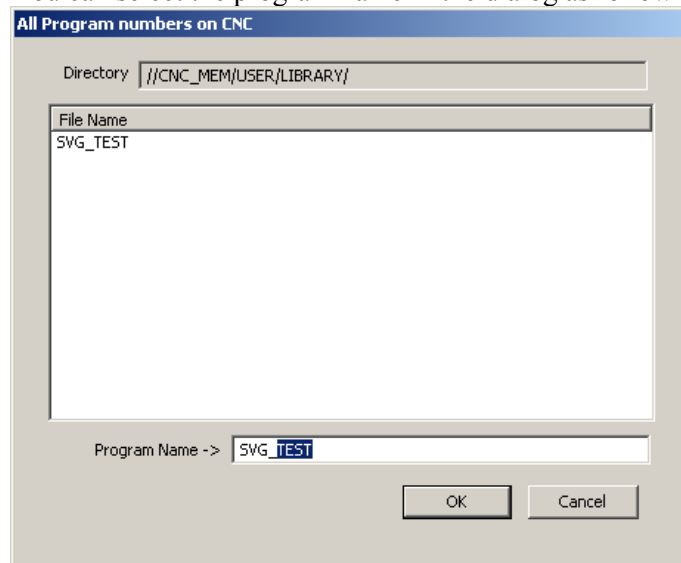
This section explains for the menu contents in program window.

[File]

- Clear and make new file (Ctrl+N)
This function is to clear the current program and to make the new program.
- Load from file (Ctrl+R)
This function is to load the program from file. The supported program format is only text format.
- Load from NC (Ctrl+T)
This function is to load the program from program memory in NC.
- At the time of the FS16i connection
You can select the program number in the dialog as following one.



- At the time of the FS30i connection
You can select the program name in the dialog as following one.



- Close
This function is to close the program window.
- Reconnection
When you use ONLINE state,
In the case that the communication error occurs for some reason,
this command will restore the communication.
(Example, it is necessary to turn off the NC at changing some
parameters. At the time it is necessary to use this function.)
- Save (Ctrl+S)
This function is to save the program file without changing the
name.
- Save As...
This function is to save the program file with changing the name.
The text format is only supported.
- Print (Ctrl+P)
This function is to print the program.
- End of application
This function is to terminate the SERVO GUIDE.

[Edit]

You can edit directly the program in program edit box. You can use
the following commands like ordinary editor.

- Cut (Ctrl+X)
- Copy (Ctrl+C)
- Paste (Ctrl+P)
- Select All (Ctrl+A)
- Search (Ctrl+F)

[Display]

- Tool bar
This function is to switch ON/OFF of tool bar.

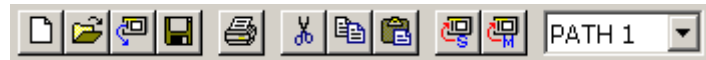
[Tool]

- Sub-program transmission (Ctrl+B)
- At the time of the FS16i connection
It is transferred to the program memory of NC in the O number
which established the program made by the program editing box
by the <number choice> button.
- At the time of the FS30i connection
It is transferred to the program memory of NC by the file name
which established the program made by the program editing box
by the <file choice> button. A file will save in the folder of
//CNC_MEM/USER/LIBRARY/.
- Main-program transmission (Ctrl+M)
To run the transmitted Sub-program, [Program to load
Sub-program], we call it Main program, is transmitted to MDI
buffer in NC. After that process, if you press the [Cycle start],
you can run the program.
- Delete program on NC
This function is to delete the program on NC's memory. You can
select the program you want to delete in the dialog.

6.3 TOOL BAR

Tool bar of program window

The following tool bar is displayed in the Program Window:



<1><2><3><4> <5> <6><7><8> <9><10> <11>

Tool bar is displayed under the menu. You can operate the various commands used in program window with pressing the icon by the mouse.

You can decide whether tool bar is displayed or not with pressing the [Tool bar] command button in [Display] menu.

Number Function

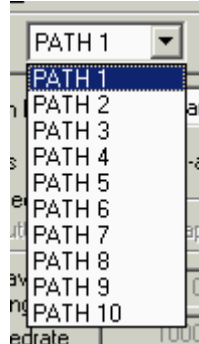
- <1> Clear the program and make new program.
- <2> Open the program (text format).
- <3> Load the program from NC.
- <4> Save the program (text format).
- <5> Print the program.
- <6> Cut the program code.
- <7> Copy the program code.
- <8> Paste the program code.
- <9> Transmit the Sub-program.
- <10> Transmit the Main-program.
- <11> Select the target path for operation. In the offline state, nothing is indicated.

6.4 USAGE

ON LINE

You can make the test program in the following process.

1. The first is to select the path to use.



* Selectable path is indicated in the case of the on-line system.
In the case of the off-line system, you can't select it.

2. The second is to select the program mode.



You can select the test program as the upper example.

On [Free program] mode, you can write directly the arbitrary program in program edit box.

* There is the following limit in making the programs.

Rigid tapping :

Only Z-axis is supported as tapping axis.

Cs contouring control :

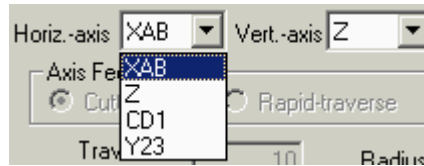
Only C-axis is supported as Cs contouring control.
(And only square with 1/4 arc program is supported.)

3. If you use the lathe, it is necessary to set the following item.



* In ON LINE mode, when the program window start up, automatically the parameter will be loaded and the upper setting will be set.

4. Select the axis to use.



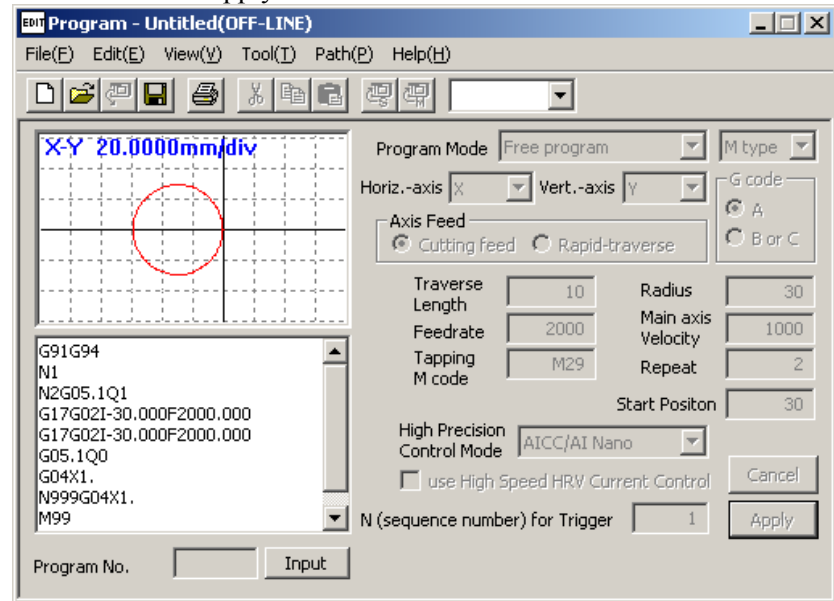
- * The axis name of the system being chosen path is indicated in the case of the on-line system. In the case of the off-line system, the axis name becomes a XYZABC fixation.

5. You can set the other condition.

The program except for the Cs contouring is made by the incremental command. The point of cycle start become (0, 0).

Item	Description
Moving distance	Input the moving distance of one way on the back and forth Acc./Dec.
Side segment	In the square or the square with 1/4 arc (include Cs), input the side segment length. In case of the square with 1/4 arc, it is necessary to input the straight length except for the arc line.
Screw length	Input the distance from R point to screw bottom on the rigid tapping mode.
Radius	Input the radius of the circle. In case of the square with 1/4 arc (include Cs), input the radius of corner.
Start-R distance	Input the distance from start point to R point in the rigid tapping mode.
Traverse speed	Input the traverse speed on servo axis.
Spindle speed	Input the spindle speed by the "min ⁻¹ " unit on the rigid tapping mode.
Spindle revolution M code	Input the M code to start spindle revolution in the rigid tapping mode. (Usually M29)
Count	Input the repeat count of program. If you want to move round twice, input "2" here.
Start point X coordinate	The program only on Cs contouring control is interpolated with polar coordinates. Then, it is necessary to make the program with absolute coordinate and to input the X coordinate of the start point.
High precision function	Select advanced preview control, AI contour control, and so on. This combo box shows the usable high speed & high precision functions depending on the options.
High-speed HRV control enable	If you run the program in high-speed HRV mode, check this.
N number for trigger	In Graph Window, you can set the start trigger of measurement by the N number. When you set a number here, N number is added in program head.

6. Press the <Apply> button.



7. You can edit directly the program codes in program edit box. Edit it as the need arises. (After editing , it is necessary to press the <Apply> again.)
8. It is necessary to press the [Sub-program transmission] in [Tool] menu for transmission of this program. (In the tool bar there is the button that has the same effect.)
9. Next you transmit the Main-program to run this program. Press the [Main-program transmission] in [Tool] menu. (In the tool bar there is the button that has the same effect.)
10. The preparation to run the program is terminated. Press the [Cycle start] button of machine , run the program.

NOTE

HPCC, AIHPCC and AINanoHPCC can't be executed by sub-program call in the past. But we revised it in the following CNC software editions. You can use them as same as other High speed & High precision modes.

(Supported NC software)

Series 16*i*-MB : B0H1-20 or later, B0HA-01 or later

Series 16*i*-TB : B1H1-20 or later, B1HA-01 or later

Series 18*i*-MB : BDH1-20 or later, BDHA-01 or later

Series 18*i*-TB : BEH1-20 or later, BEHA-01 or later

Series 18*i*-MB5 : BDH5-10 or later

11. You can save the made program as the file. You can print, too.

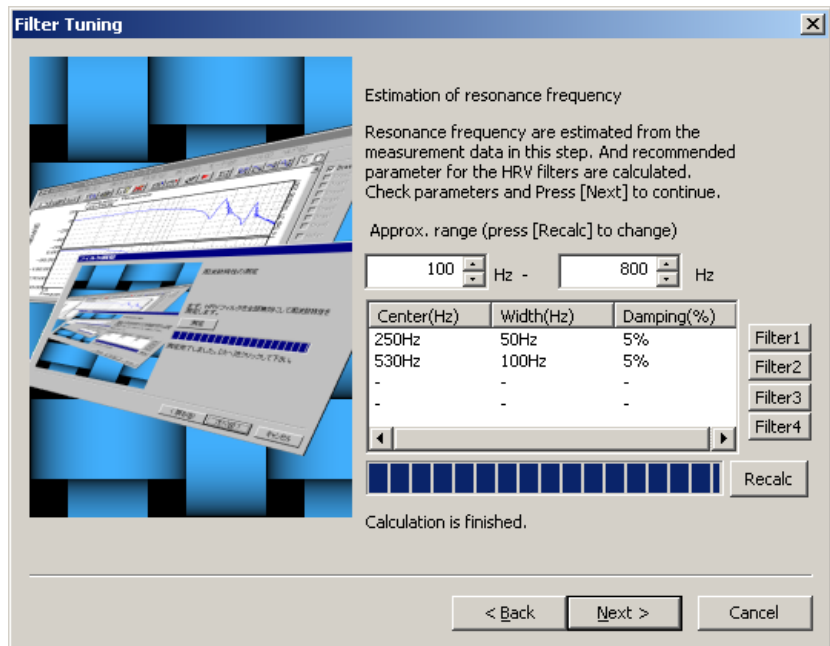
OFF LINE

Even when the Program Window is not connected to the NC, programs may be created. Create a program by following steps 1 through 4 described previously.

You can save and print the made program same as the ON LINE state.

7

TUNING NAVIGATOR



Tuning Navigator supports tuning operations by showing a procedure in Wizard form.

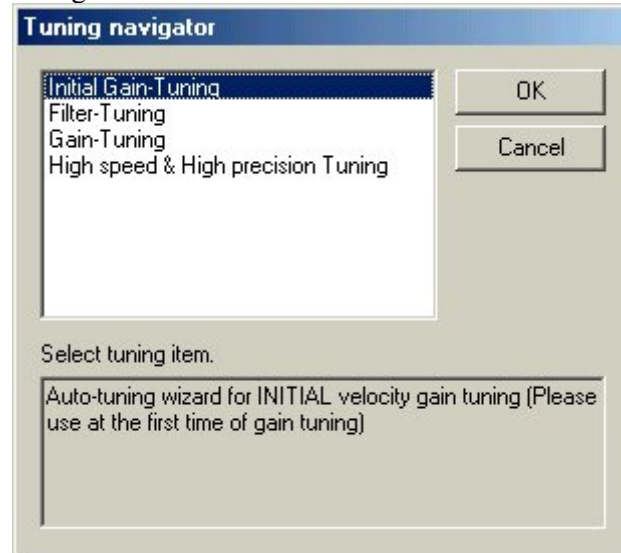
So far, the following tuning operations are supported:

- Automatic tuning of velocity loop gain
- Automatic tuning of resonance elimination filters
- Support of high-speed and high-precision function setting

Use the tuning wizard when it is connected to the NC.

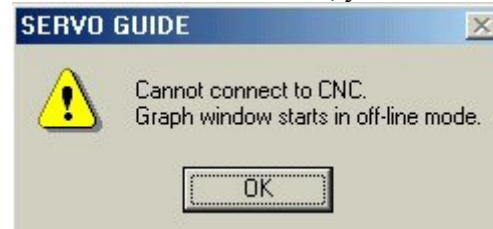
7.1 OVERVIEW

If you press the <Navigator> button in main bar, you see the following dialog.



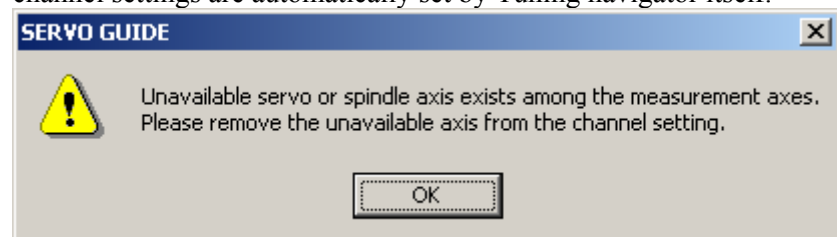
Select on item to tune in this menu.

Tuning navigator determine the parameters, getting waveform from CNC automatically. Therefore use it with connecting CNC. If you use it without CNC connection, you see the following message.



It is necessary to change to MDI mode on NC and to select the display except for program edit display. (Position display is recommended.)

As Tuning navigator works with Graph window together, Graph window is automatically opened. As Graph window remember the former settings(channel, mode, etc.), you may see the following message by any chance. In that case, ignore it by pushing <OK>. (The channel settings are automatically set by Tuning navigator itself.



The following table shows the items and contents to tune.

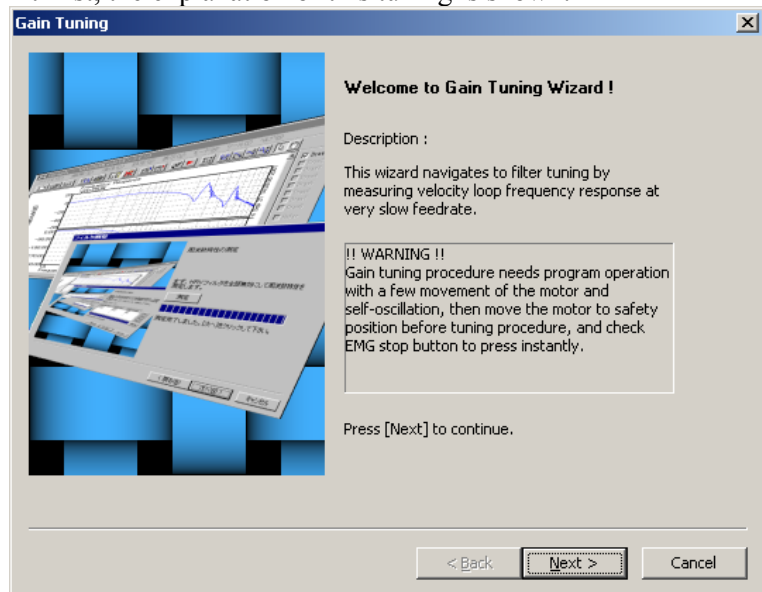
Tuning item	Description
Initial Gain-Tuning	This is the automatic tuning of velocity gain. It determines the gain, moving the target axis and measuring frequency response. When you've not tune the gain yet, select this menu first.
Filter-Tuning	This is the automatic tuning of HRV filters (Resonance elimination filters). It determines the optimum filter setting by detecting resonance frequency with the gain which is determined Initial Gain-Tuning.
Gain-Tuning	After application of above filters, this wizard raise the gain more by automatic tuning.
High speed & High precision Tuning	The wizard, which makes the tuning for High speed & High precision easy, will start. The plural parameters, which are related High speed & High precision function, can be determined easily by only one slider. The square with 1/4 arc program is used for the evaluation.

7.2 INITIAL GAIN-TUNING

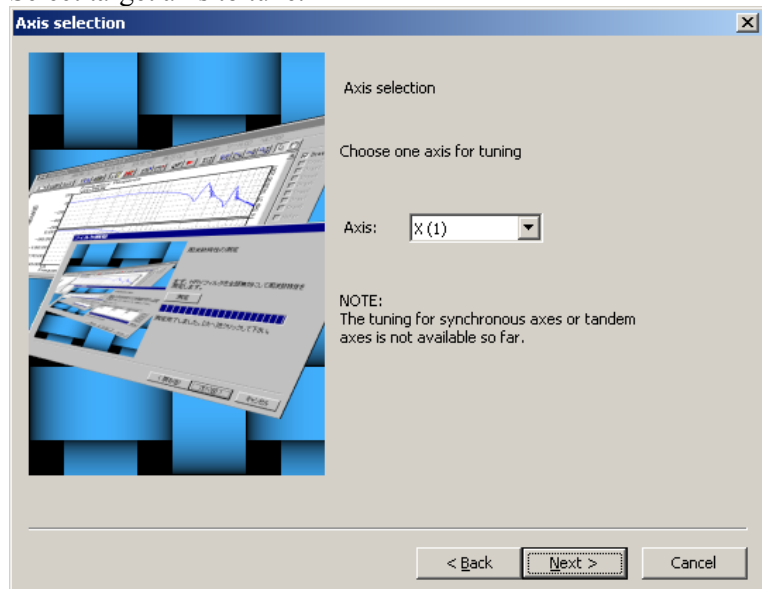
Flow of tuning

The following shows the flow of tuning:

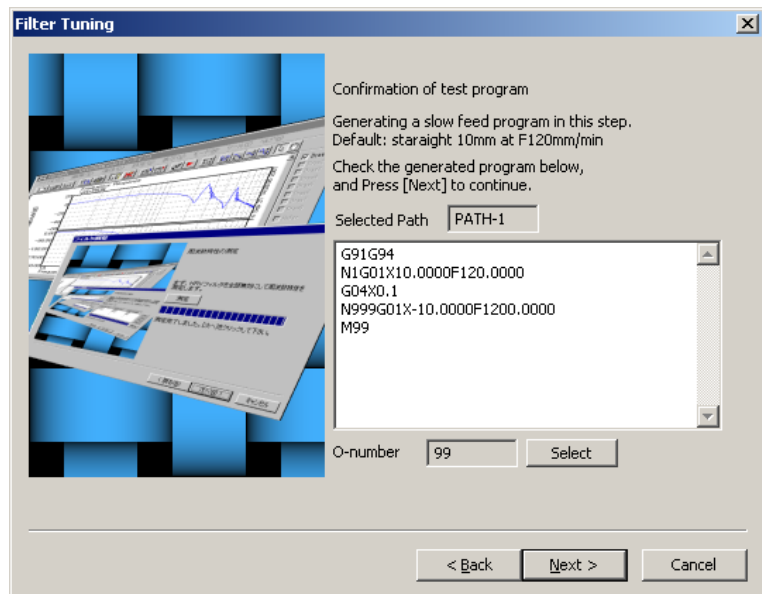
1. At first, the explanation of this tuning is shown.



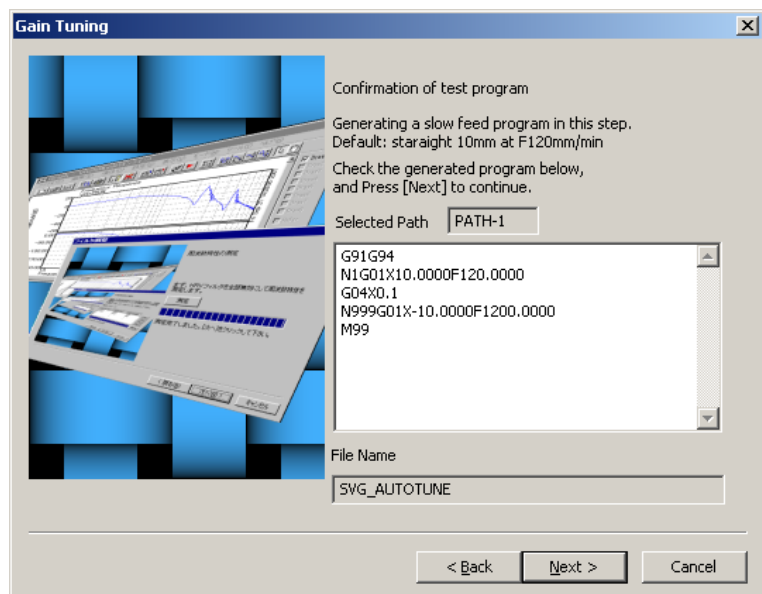
2. Select target axis to tune.



3. The test program, which is the 10mm (0.394inch in case that input unit is inch) go-back cutting as default, is shown.
 You can change it directly in the Edit-Box. (But don't change to a rapid-traverse program. Use cutting a program.)
 As the O-number 99 is used for this test program as default. If you have same number program, press [Select] button to change O-number.
 (The name of test program on FS30i becomes SVG_AUTOTUNE as fixed name, and it can't be changed.)

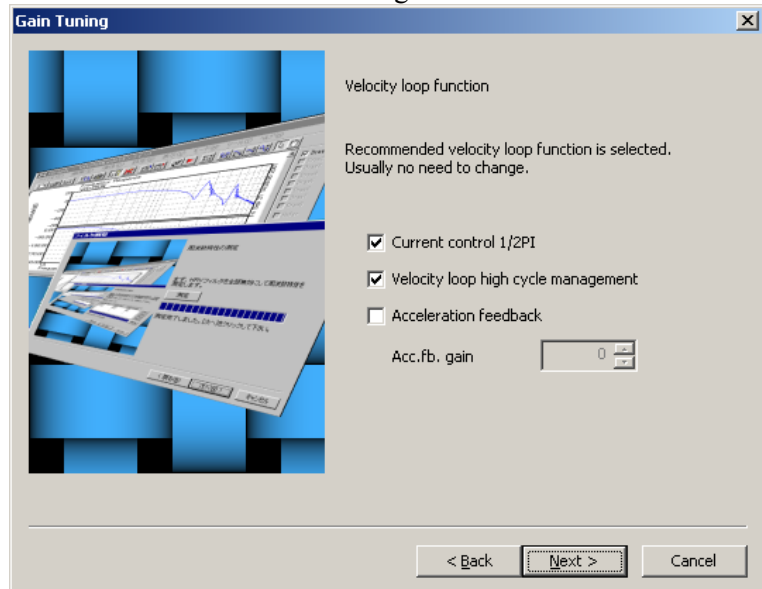


→ FS16i



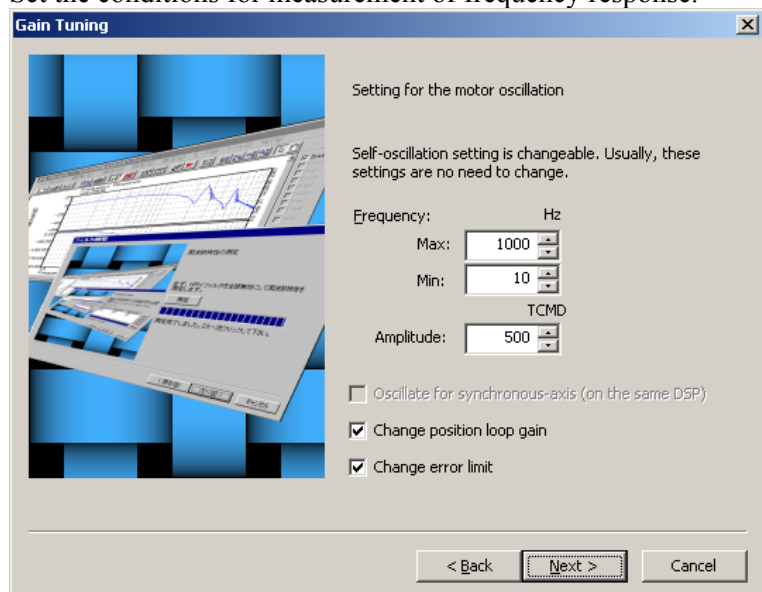
→ FS30i

4. Set basic conditions before tuning.



Basically, we recommend you to use "Current control 1/2PI" and "Velocity loop high cycle management". So you don't have to change it. (If you want not to use them, turn them OFF.)

5. Set the conditions for measurement of frequency response.



Ordinarily, You don't have to change them all.

If you see too much noise in the high frequency domain your measurement result, change "Amplitude" larger. On the contrary, if the vibration is too much and some alarms (OVC alarm etc.) occur, change "Amplitude" smaller.

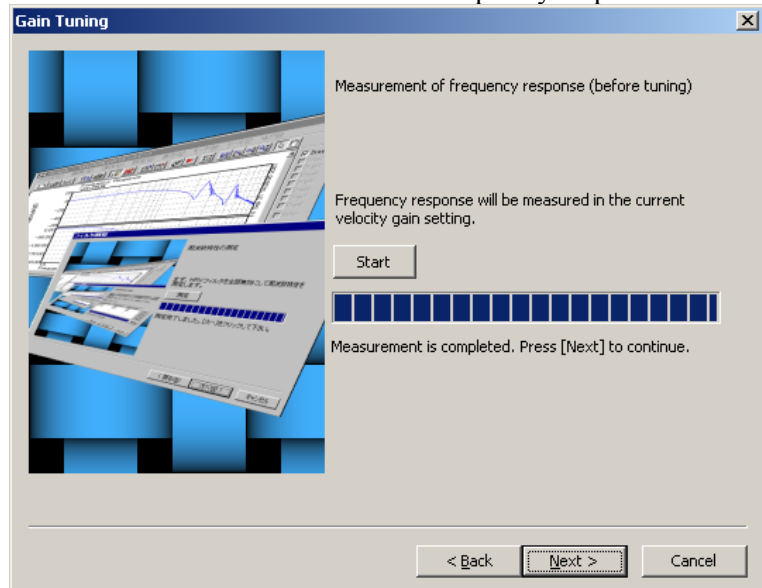
Set "Change position loop gain" to neglect the position gain effect during the measurement of frequency response of velocity loop.

Set "Change error limit" to avoid "Excess error alarm" during the measurement.

NOTE

When the machine uses the dual check safety function, uncheck "Change error limit".

6. Press <Start> button to measure the frequency response.

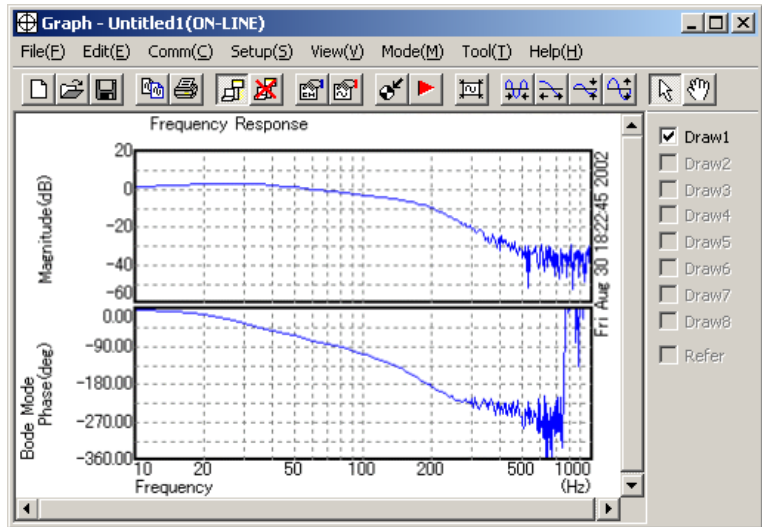


When you press <Start> button, the test program is transmitted to CNC first. Wait until the message "Press START button and execute the program". After that, when you press "Cycle Start" button on the machine MDI, the machine must be moved and the getting data is started. Wait until the message "Measurement is completed".

NOTE

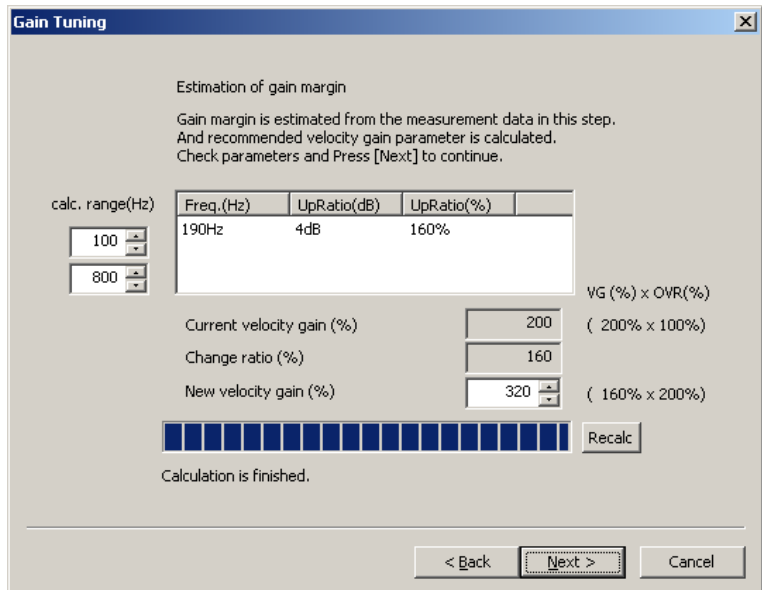
In first try, PC may start to get data without trigger waiting just after press [Start]. At the case, try again after moving machine by press of Start button on the machine MDI. The waiting trigger must be done correctly at your second try. If a trigger still cannot occur properly, see the description of troubleshooting.

After measurement, the waveform must be shown on Graph Window.

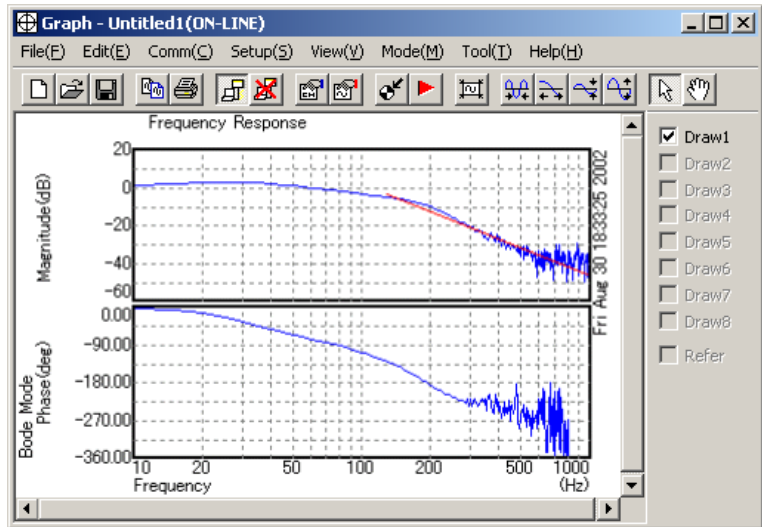


Press [Next>] button.

7. The up-ratio against the current gain is shown.



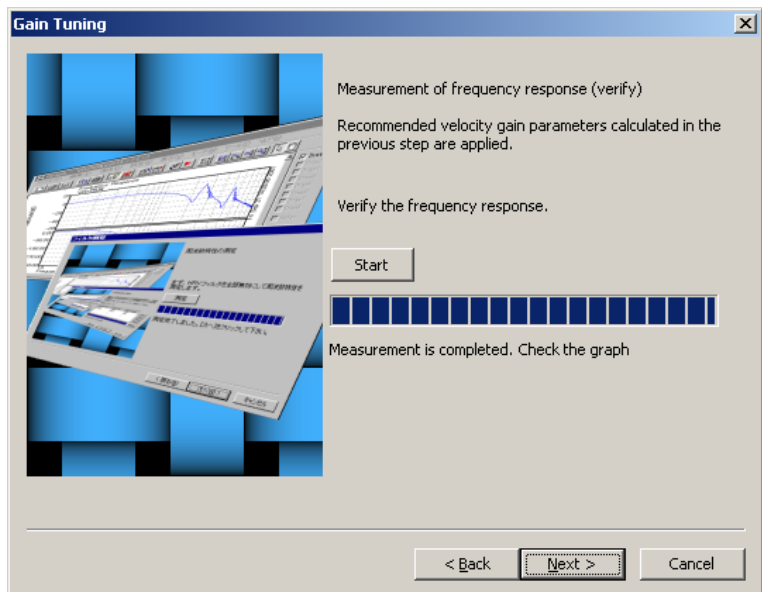
The evaluation of the measurement result is executed. And the red line, which indicates the ideal frequency response without any resonance, is shown like following.

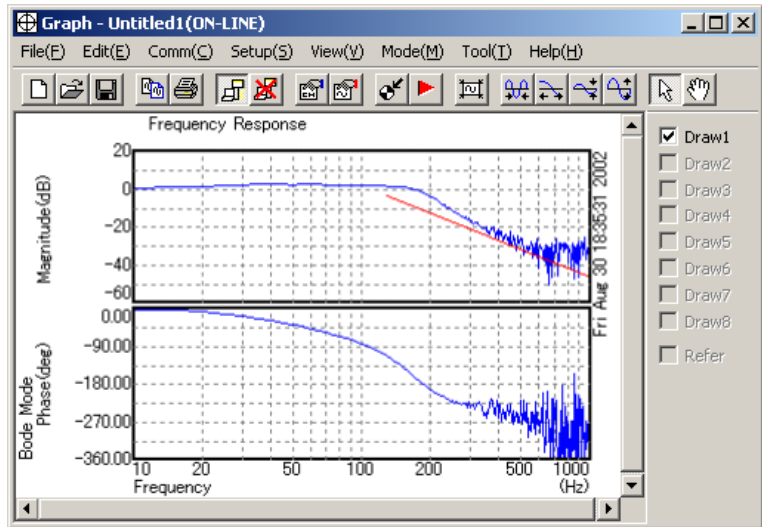


SERVO GUIDE finds the resonance point and determines the up-ratio by comparison of real response and ideal response. It is difficult to determine the ideal response if the result is noisy in the high frequency domain. So SERVO GUIDE limit the frequency domain to evaluate it. It is from 100Hz to 800Hz as default, but you can change it. (If you change it, press <Recalc> button. The calculation is executed again.

The final setting of the gain can be changed manually by changing edit-box directly.

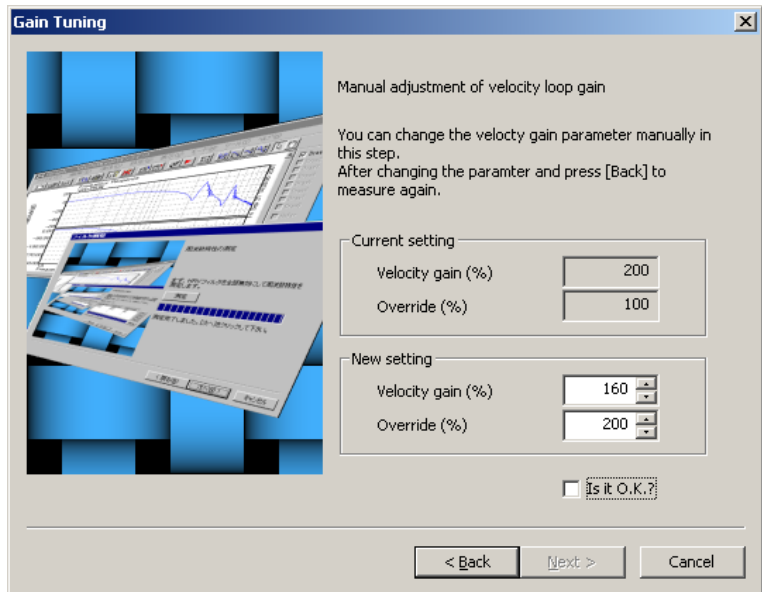
8. We measure the frequency response again to confirm the effect of gain up.
The procedure is same as 6.





You can see the effect of gain up by comparison of red line(former response) and blue line.

9. The final setting value of parameters is shown.



This function automatically turn on "Cutting/Rapid velocity loop gain switching function".

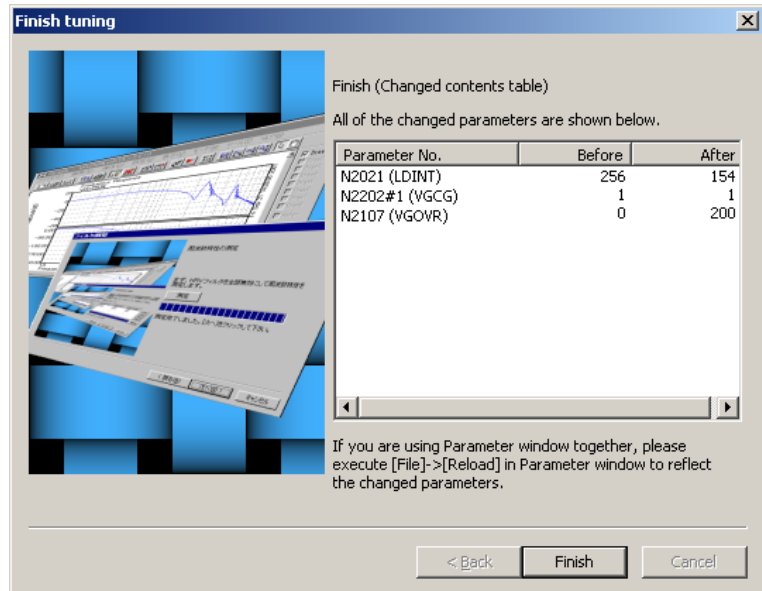
"Velocity gain" is used for rapid-traverse. And "Velocity gain × Over-ride" is used for cutting. (The over-ride value is 200% as default.)

If you want to change the shown values, change manually by changing edit-box directly.

To check the frequency response as a result of the change, press the <Back> button to return the screen display to the previous screen and measure the frequency response.

When the result satisfy you, check [Is it O.K.?] and press <Next>> button.

10. The list of changed parameters is shown in the last.



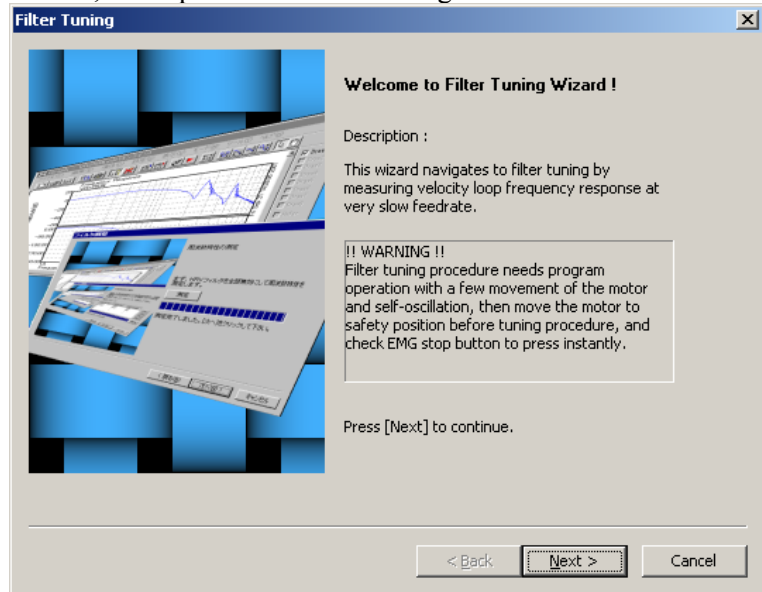
If you are using Parameter window together, execute [File]->[Reload] in Parameter window to reflect the changed parameters.

7.3 INITIAL FILTER-TUNING

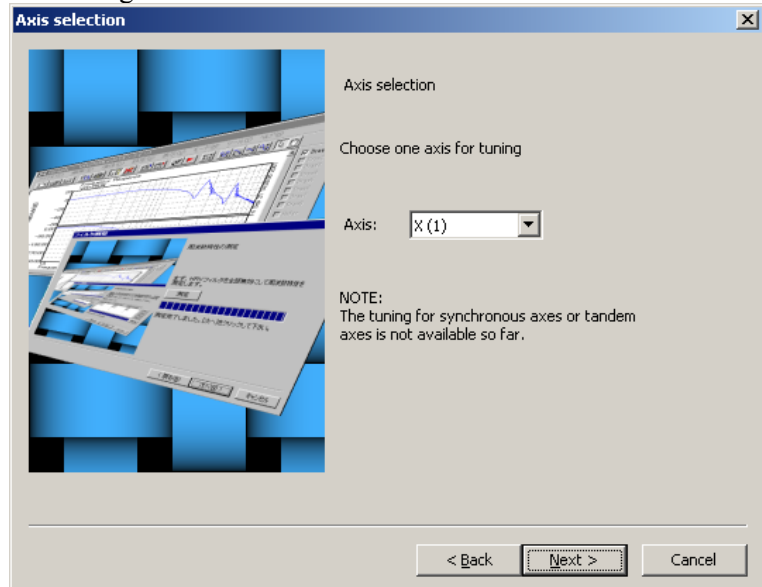
Flow of tuning

The following shows the flow of tuning:

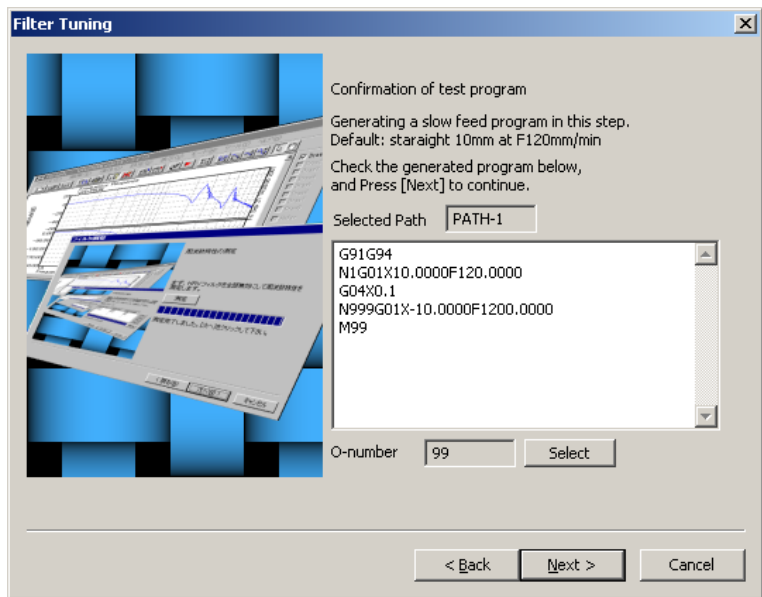
1. At first, the explanation of this tuning is shown.



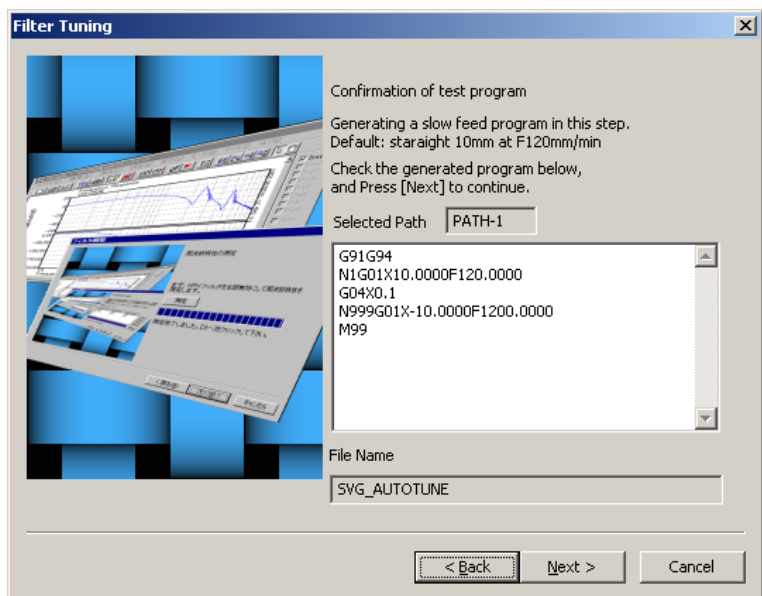
2. Select target axis to tune.



3. The test program, which is the 10mm (0.394inch in case that input unit is inch) go-back cutting as default, is shown.
 You can change it directly in the Edit-Box. (But don't change to a rapid-traverse program. Use cutting a program.)
 As the O-number 99 is used for this test program as default. If you have same number program, press [Select] button to change O-number.
 (The name of test program on FS30i becomes SVG_AUTOTUNE as fixed name, and it can't be changed.)

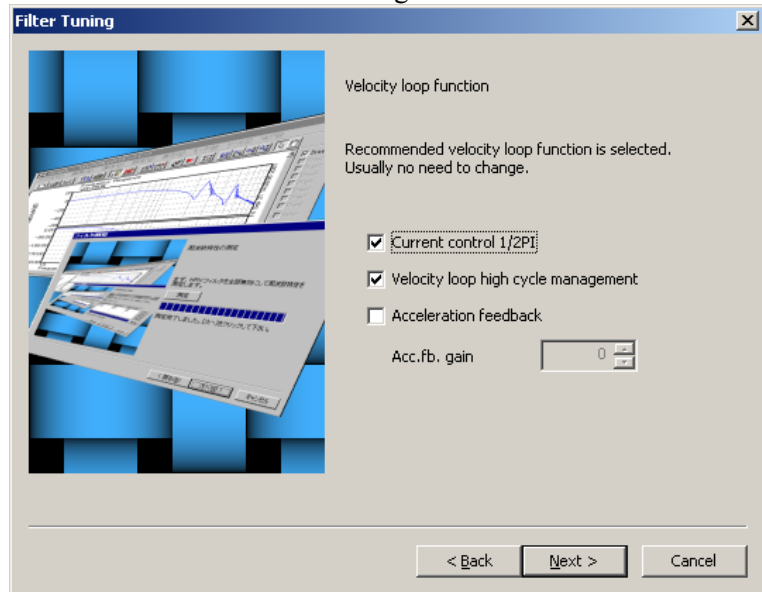


→ FS16i



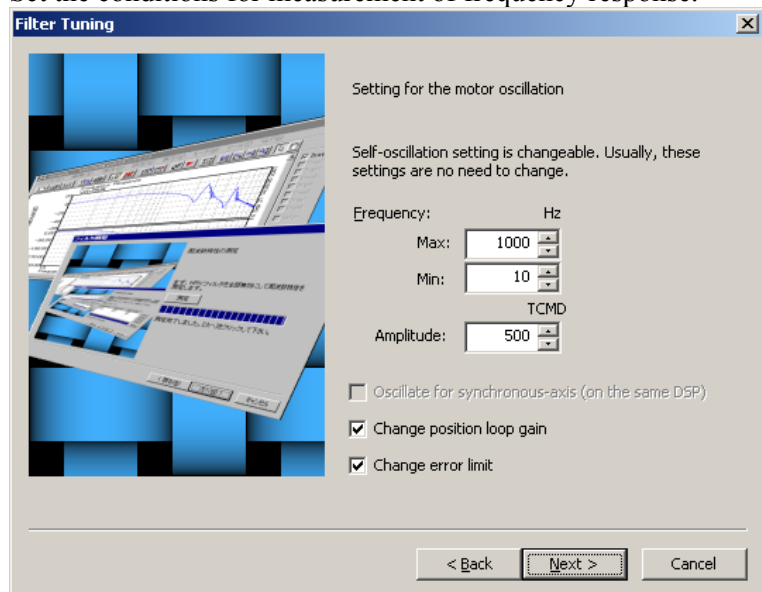
→ FS30i

4. Set basic conditions before tuning.



Basically, we recommend you to use "Current control 1/2PI" and "Velocity loop high cycle management". So you don't have to change it. (If you want not to use them, turn them OFF.)

5. Set the conditions for measurement of frequency response.



Ordinarily, you don't have to change them all.

If you see too much noise in the high frequency domain your measurement result, change "Amplitude" larger. On the contrary, if the vibration is too much and some alarms (OVC alarm etc.) occur, change "Amplitude" smaller.

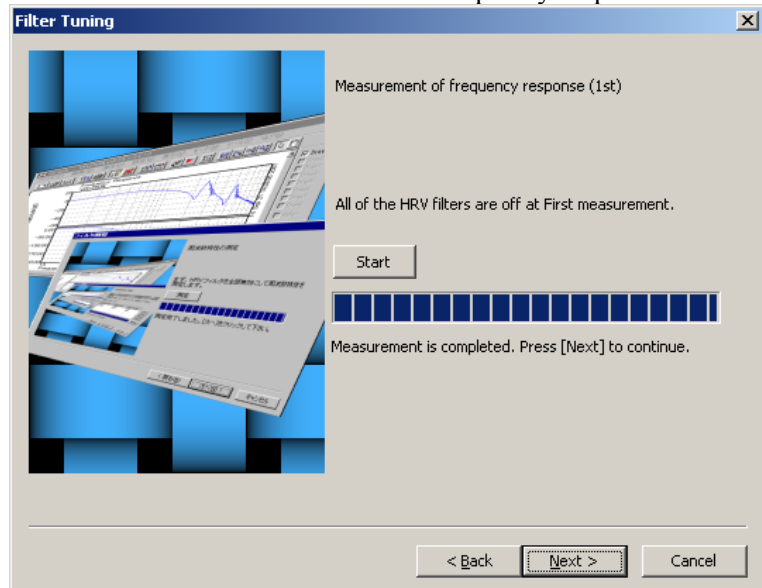
Set "Change position loop gain" to neglect the position gain effect during the measurement of frequency response of velocity loop.

Set "Change error limit" to avoid "Excess error alarm" during the measurement.

NOTE

When the machine uses the dual check safety function, uncheck "Change error limit".

6. Press <Start> button to measure the frequency response.

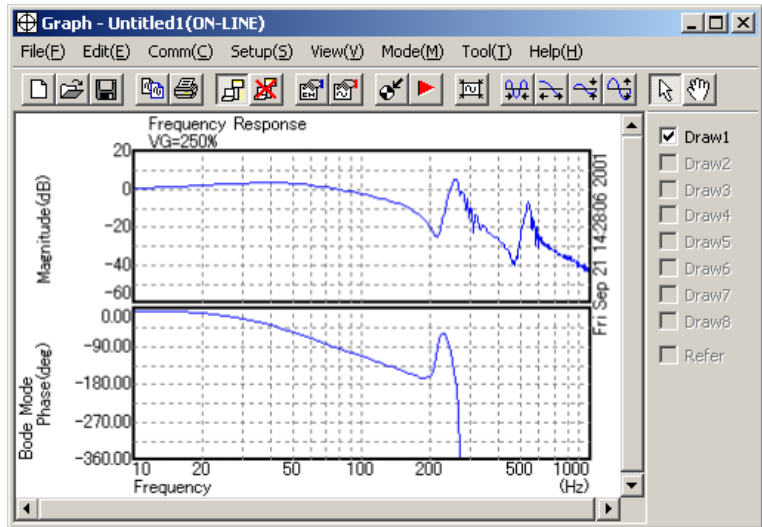


When you press <Start> button, the test program is transmitted to CNC first. Wait until the message "Press START button and execute the program". After that, when you press "Cycle Start" button on the machine MDI, the machine must be moved and the getting data is started. Wait until the message "Measurement is completed".

NOTE

In first try, PC may start to get data without trigger waiting just after press <Start>. At the case, try again after moving machine by press of Start button on the machine MDI. The waiting trigger must be done correctly at your second try.
If a trigger still cannot occur properly, see the description of troubleshooting.

After measurement, the waveform must be shown on Graph Window.

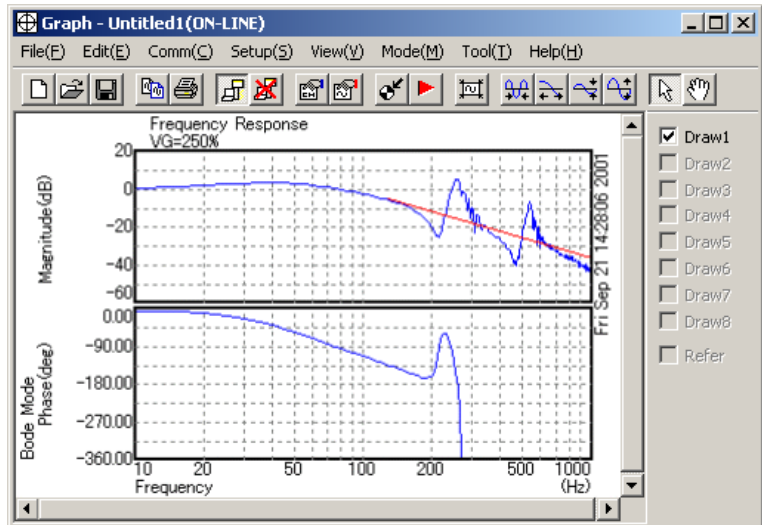


Press <Next> button.

7. The coefficients for filters are calculated.

Center(Hz)	Width(Hz)	Damping(%)
250Hz	50Hz	5%
530Hz	100Hz	5%
-	-	-
-	-	-

The evaluation of the measurement result is executed. And the red line, which indicates the ideal frequency response, is shown like following.

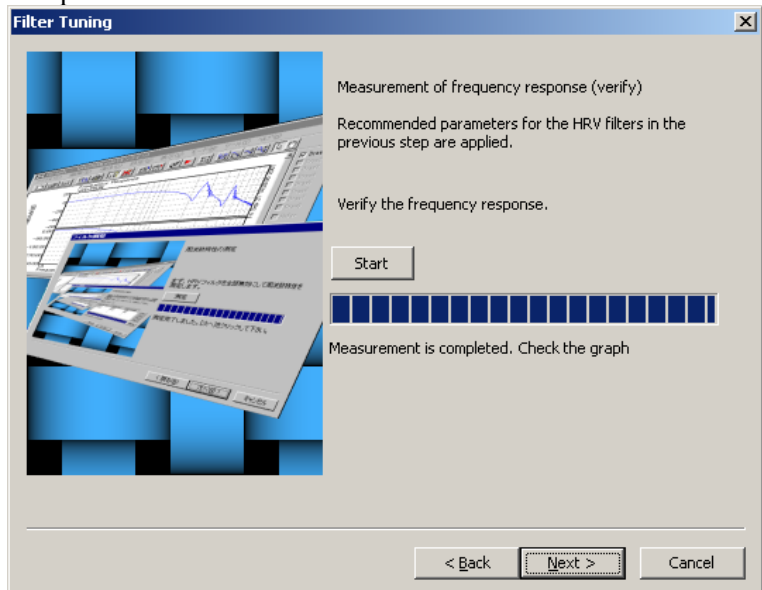


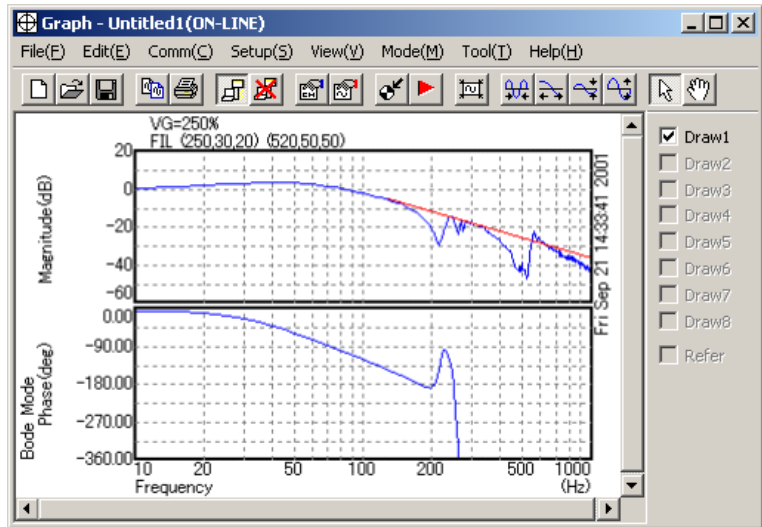
SERVO GUIDE finds the resonance point and optimum filters by comparison of real response and ideal response. It is difficult to determine the ideal response if the result is noisy in the high frequency domain. So SERVO GUIDE limit the frequency domain to evaluate it. It is from 100Hz to 800Hz as default, but you can change it. (If you change it, press <Recalc> button. The calculation is executed again.)

An optimum filter value can also be changed manually by pressing the corresponding button from <Filter1> to <Filter4>.

8. We measure the frequency response again to confirm the effect of filters.

The procedure is same as 6.





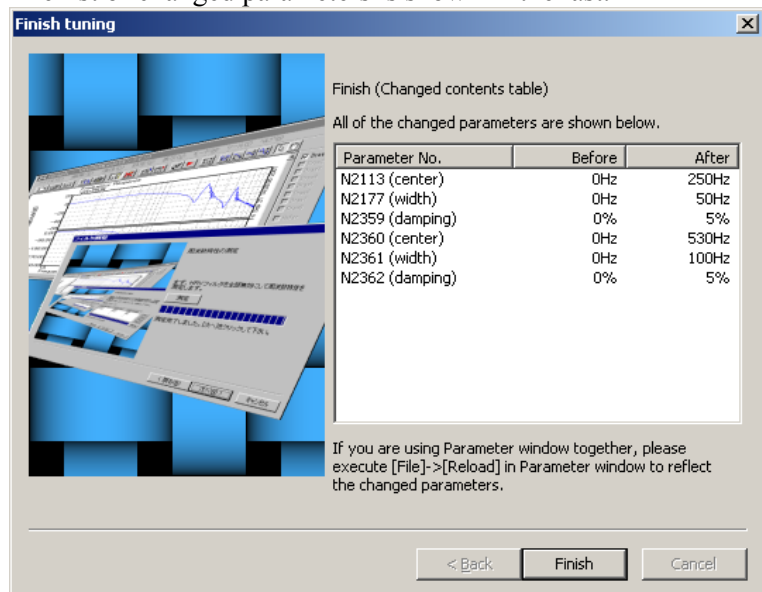
9. After the frequency response result measured after the application of the filters is checked, the filters can be fine-tuned manually.

Center(Hz)	Width(Hz)	Damping(%)	Change
250Hz	50Hz	5%	Filter1
530Hz	100Hz	5%	Filter2
-	-	-	Filter3
-	-	-	Filter4

When changing a filter parameter, press the corresponding button <Filter1> to <Filter4>. After changing the coefficients, press [< Back] button and execute the measurement again.

When the result satisfy you, check [Is it O.K.?] and press <Next>> button.

10. The list of changed parameters is shown in the last.



If you are using Parameter window together, execute [File] → [Reload] in Parameter window to reflect the changed parameters.

7.4 GAIN-TUNING

Difference between two Gain tunings

There are two types of Gain tunings. One is "Initial Gain-Tuning" and the other is "Gain-Tuning".

In "Initial Gain-Tuning", the velocity gain is determined with large margin against the limit of vibration level. When you use this tuning, the gain become a little larger than initial state, and the resonance of the machine becomes more clear.

Next, we reject the resonance by Filter-Tuning.

"Gain-Tuning" is used for final determination without any resonance. This function realizes the high gain by cutting the gain margin.

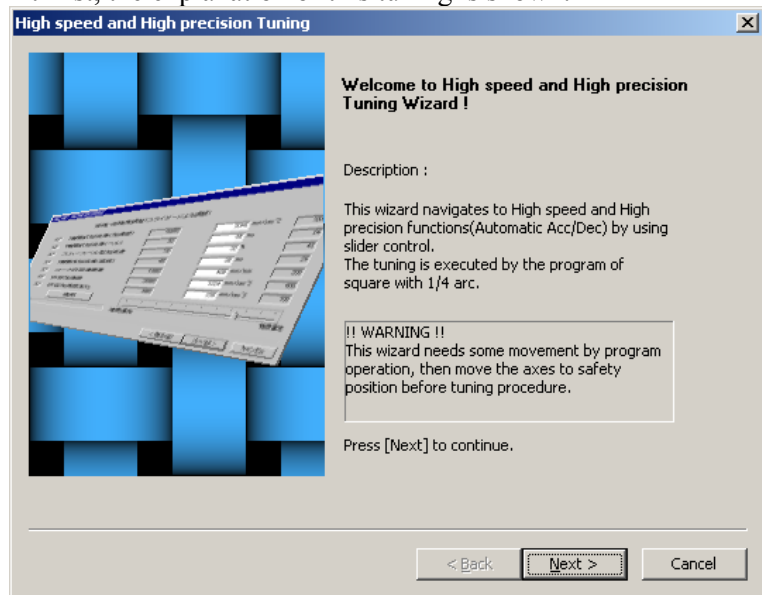
The procedure of "Gain-Tuning" is exactly same as "Initial Gain-Tuning". Refer to Section 7.2

7.5 HIGH-SPEED AND HIGH-PRECISION TUNING

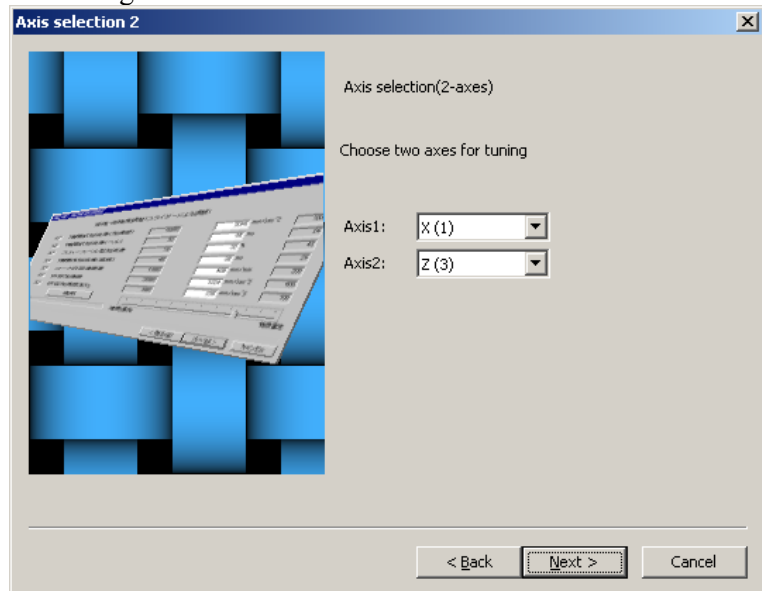
Flow of tuning

The following shows the flow of tuning:

1. At first, the explanation of this tuning is shown.



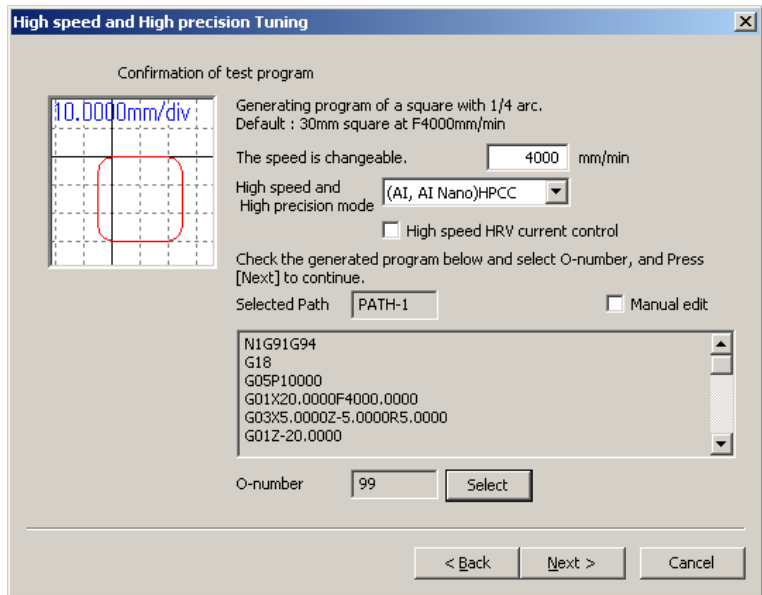
2. Select target axes to tune.



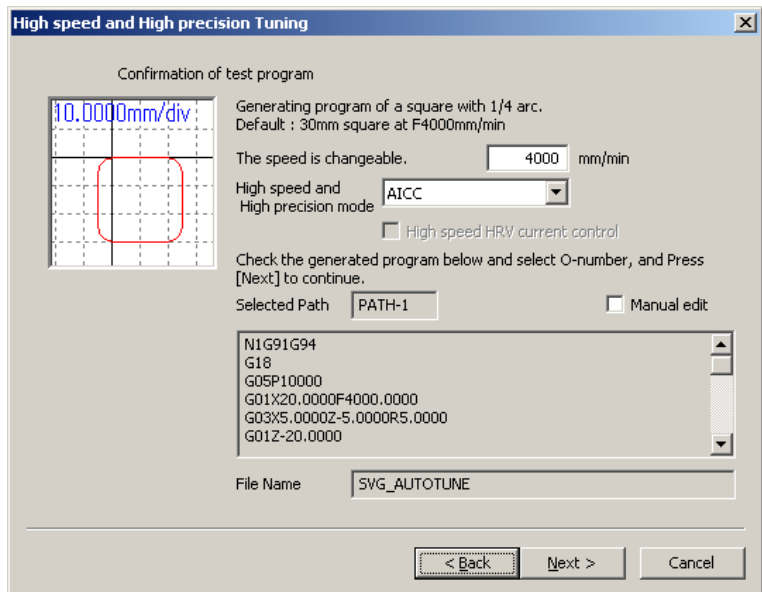
- The test program, which is the 30mm (1.181inch in case that input unit is inch) square with R5 (R0.197inch in case that input unit is inch) 1/4arc, is shown.

You can change only speed and High precision mode only here. As the O-number 99 is used for this test program as default. if you have same number program, press <Select> button to change O-number.

(The name of test program on FS30i becomes SVG_AUTOTUNE as fixed name, and it can't be changed.)

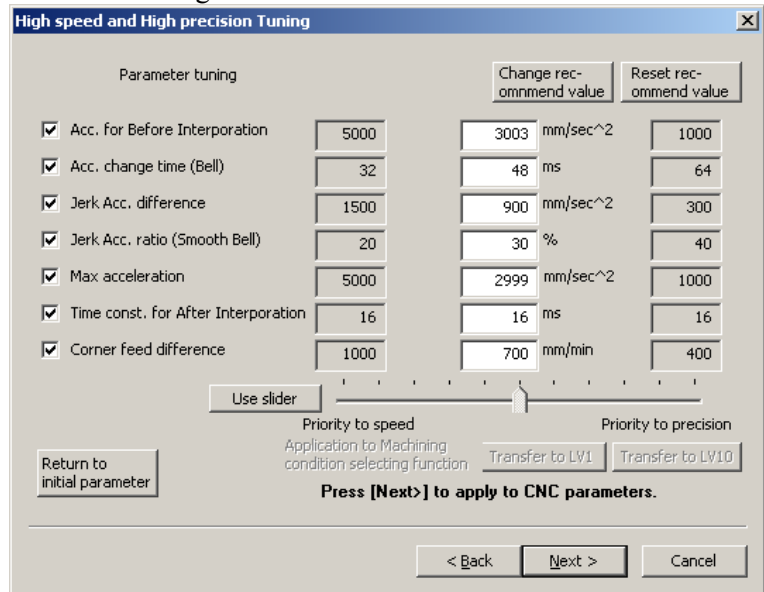


→ FS16i

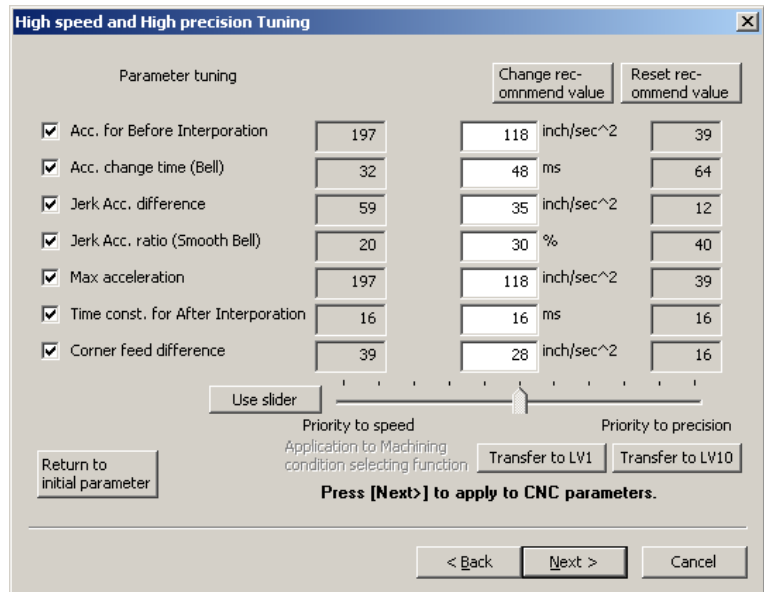


→ FS30i

4. Parameter tuning screen is shown.



→ Case of mm system



→ Case of inch system

Initially the parameter values, which are read from CNC, are shown in the white edit-boxes.

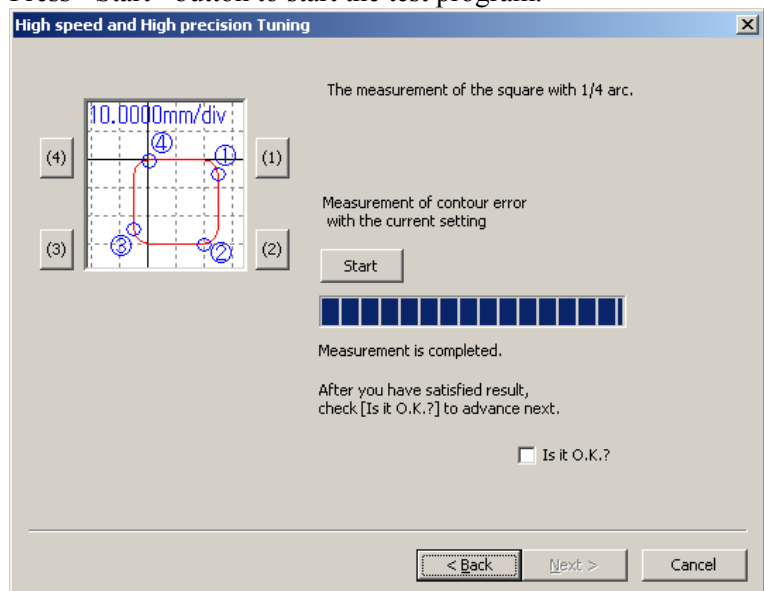
You can edit the value directly. And when you press [Use slider], you can change all parameter together only by one slider moving. The gray boxes, which are located both side of white edit boxes, shows the recommended parameter sets. The left side parameter set is for the priority to speed. The right side parameter set is for the priority to precision. The values, which FANUC recommends, are shown initially in the boxes as default. You can easily set the interpolated value from both sides by this system.

In this screen, when you press <Next>> button, the parameters to change are transmitted to CNC.

This is the explanation of other buttons on this screen.

Button	Explanation
Return to initial parameter	It returns the parameter settings to the initial value. (Both PC-side and NC-side)
Change recommended value	The parameter sets for speed priority and precision priority can be changed. If you change them, the values are remembered by Registry data base. They are always used after that.
Reset recommended value	It returns the value of recommended parameter sets to initial FANUC recommended one.
The check box left-side of each functions	Turn off the check box, if you want the parameter. The check box may be automatically OFF according to your option configuration.

5. Press <Start> button to start the test program.

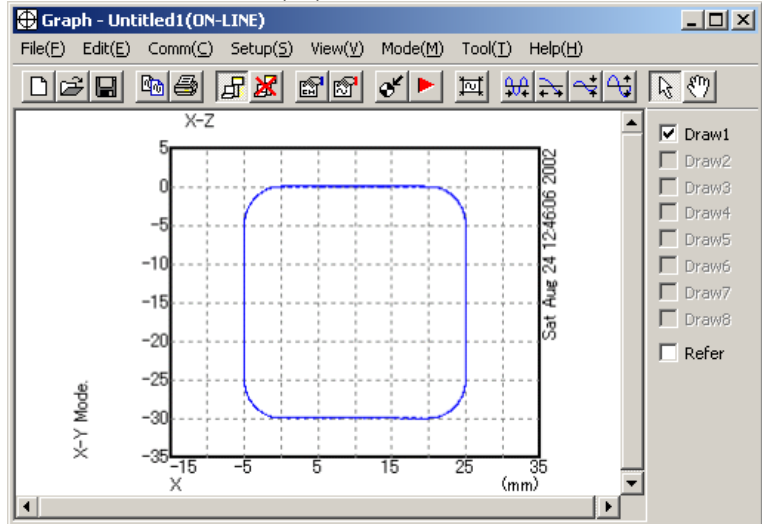


When you press <Start> button, the test program is transmitted to CNC first. Wait until the message "Press START button and execute the program". After that, when you press "Cycle Start" button on the machine MDI, the machine must be moved and the getting data is started. Wait until the message "Measurement is completed".

NOTE

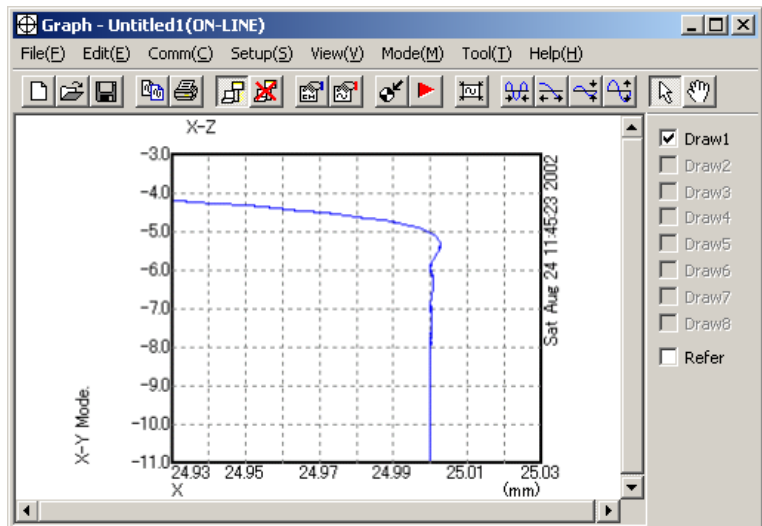
In first try, PC may start to get data without trigger waiting just after press <Start>. At the case, try again after moving machine by press of Start button on the machine MDI. The waiting trigger must be done correctly at your second try. If a trigger still cannot occur properly, see the description of troubleshooting.

Following waveform should be shown in Graph window after finish of measurement.(*1)



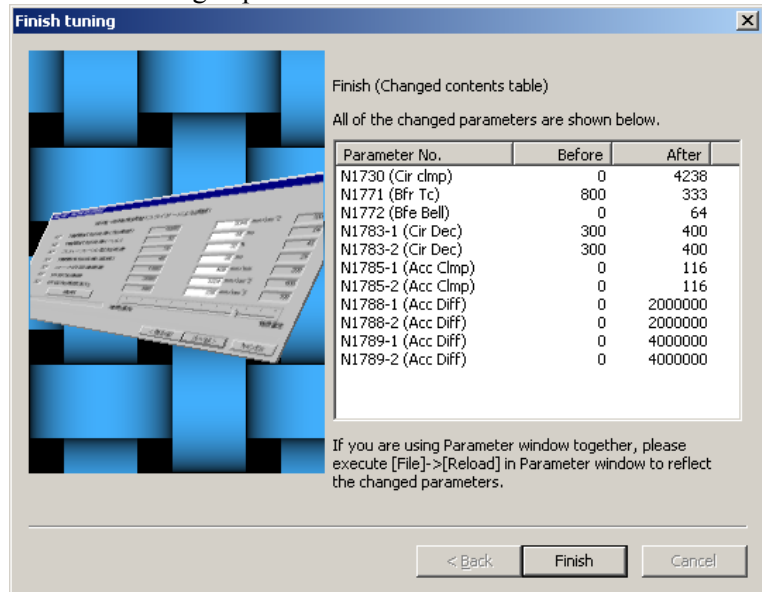
When you press <1>-<4> buttons on the High speed and High precision tuning screen, the expansion of the part, which is circle to straight line, is shown. You can evaluate your setting by this draw.(*1)

NOTE
 *1 Graph Window shows the diagram in mm unit even in case of inch system.



If you can't satisfy the result, press <<back> button and change parameters again.
 When the result satisfies you, check [Is it O.K.?] and press <Next>> button.

6. The list of changed parameters is shown in the last.



If you are using Parameter window together, execute [File] → [Reload] in Parameter window to reflect the changed parameters.

II. CONCRETE EXAMPLES

1

CONCRETE EXAMPLES

This part uses examples to specifically explain how to make measurements using the three windows of SERVO GUIDE.

- Tuning of the time constant of acceleration/deceleration in rapid traverse
- Tuning of circle
- Circle measurement for angular axis
- Tuning of square
- Tuning of square with 1/4 arc
- Tuning of rigid tapping
- Tuning of Cs contour control
- Measurement of vibrational frequency
- Measurement of the velocity loop frequency response of a servo axis
- Measurement of the velocity loop frequency response of a spindle axis
- Linear motor smoothing compensation

1.1 TUNING OF THE TIME CONSTANT OF ACCELERATION/DECELERATION IN RAPID TRAVERSE

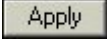
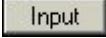

You can measure and tune in the following procedure.

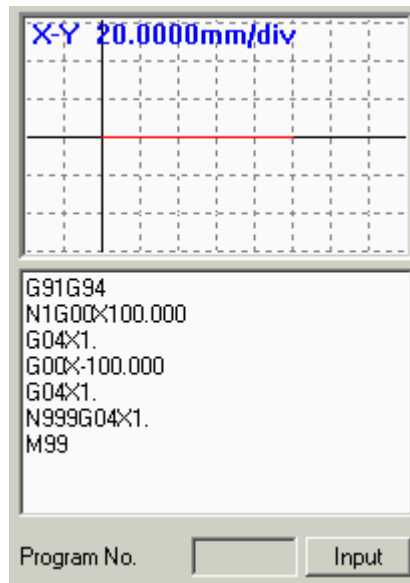
1. The first procedure is to make the test program of linear reciprocating motion in Program Window.
2. The second procedure is to set for measurement in Graph Window.
3. The third procedure is to run the program and to measure the data.
4. The fourth procedure is to tune the parameter as the need arises.

1.1.1 Test Program

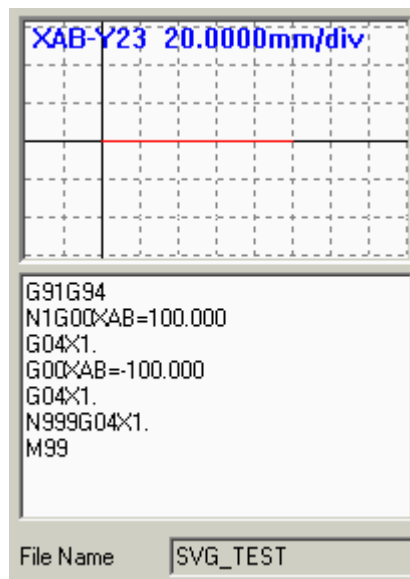
In the Program Window, you can make and send the program in the following procedure.

1. The first procedure is to make the program by setting the various conditions.



2. Decide the program by pressing the <Apply> button . At the time of the FS16i connection, the number of the program is decided by pressing the <Input> button . At the time of the FS30i connection, the name of the program is decided by pressing the <File> button .



→ FS16i




→ FS30i

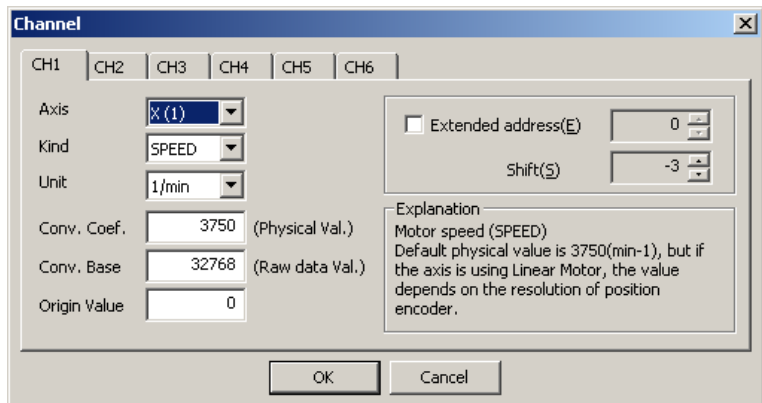
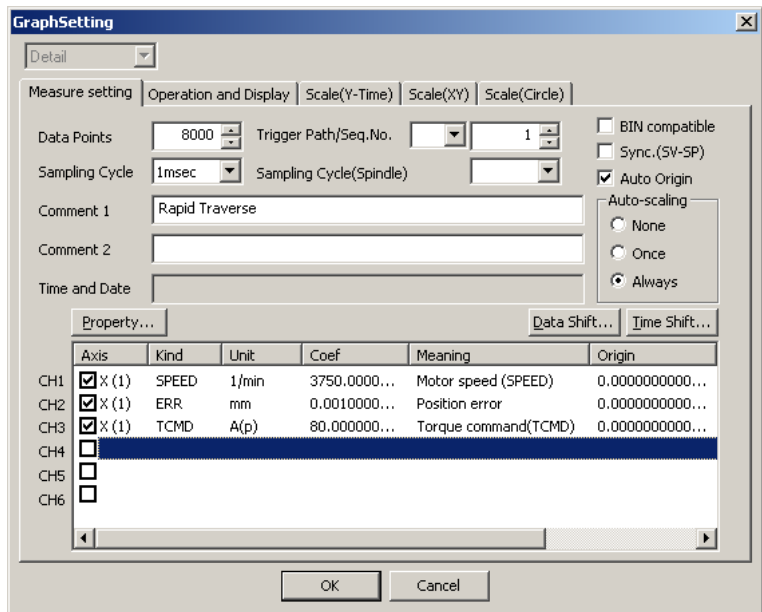
- * It is necessary to confirm the program code that SERVO GUIDE makes. If you want to modify the program and add the code for example M code, you can edit the program text directly.
- 3. The third procedure is to press the [Sub-program transmission] button , the [Main-program transmission] button .
- 4. The fourth procedure is to press the Cycle start button of machine. It is necessary to confirm that the path of program is correct.

That's all for preparation in Program Window.

1.1.2 Preparation for Measurement

It is necessary to prepare the Graph Window setting in the following procedure.

1. The first procedure is to press the [Channel setting] button  and to set the graph display setting. The sample is shown for reference.



Channel

CH1 CH2 CH3 CH4 CH5 CH6

Axis: X(1)

Kind: ERR

Unit: um

Conv. Coef.: 0.001 (Physical Val.)

Conv. Base: 1 (Raw data Val.)

Origin Value: 0

Extended address(E) 0

Shift(S) 0

Explanation
Position error
Physical value is need to set the length per pulse.
With FAD setting, this data means error for internal control loop.

OK Cancel

Channel

CH1 CH2 CH3 CH4 CH5 CH6

Axis: X(1)

Kind: TCMD

Unit: A(p)

Conv. Coef.: 80 (Physical Val.)

Conv. Base: 7282 (Raw data Val.)

Origin Value: 0

Extended address(E) 0


Shift(S) 0

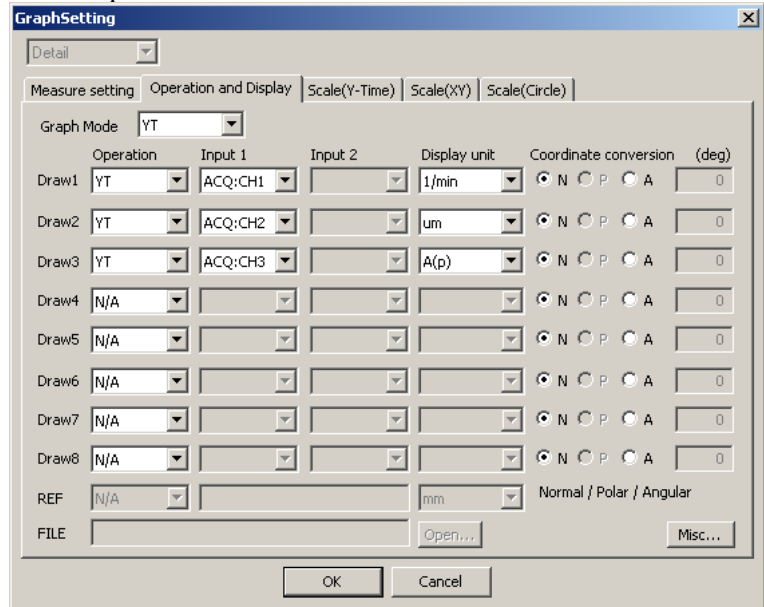
Explanation
Torque command(TCMD)
Physical value is need to set max. current (Ap) of amplifier. Default value is 100 in convention which convert measured data to percent by max. torque.

OK Cancel

In upper windows, it is set that motor speed is displayed on CH1, error is displayed on CH2, and torque command is displayed on CH3.

- * In upper example, the setting of CH3 are tuned for 80A amplifier. Set the conversion coefficient for maximum current value of amplifier you use.
2. The second procedure is to turn back main of Graph Window, to change Y-T mode by pressing [Ctrl]+[T].

- The third procedure is to set the display setting after pressing the [Calculation display] button . The sample is shown for reference.







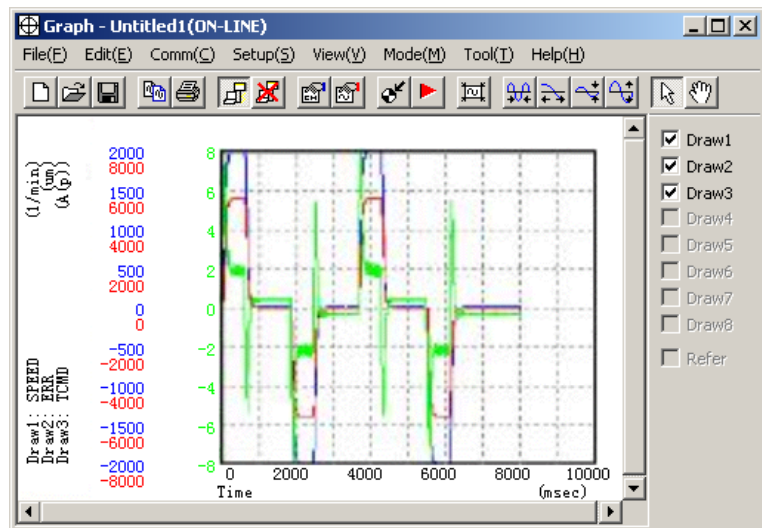
The upper window is displayed the raw results of measurement data. The data on CH1[2,3] is displayed at Draw 1[2,3]. The unit of pulse is μm because the relation between error and pulse is seen more easily.

- Returning main window, this setting is terminated.

1.1.3 Measurement

You can measure the data in the following procedure.

1. The first procedure is to press [Origin] button  at one time in Graph Window.
In case that you set trigger, press the [Measurement start] button , too. (The mode changes to trigger waiting mode.)
2. The second procedure is to press the [Main program transmission] button  in Program Window.
3. The third procedure is to run the program by the pressing the Cycle start button of machine.
In case that you set the trigger, the data measurement starts at the same time in Graph Window.
In case that you don't set the trigger, press the [Measurement start] button .
4. The following window is the sample of the measurement data.

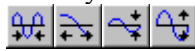


Blue: Motor speed

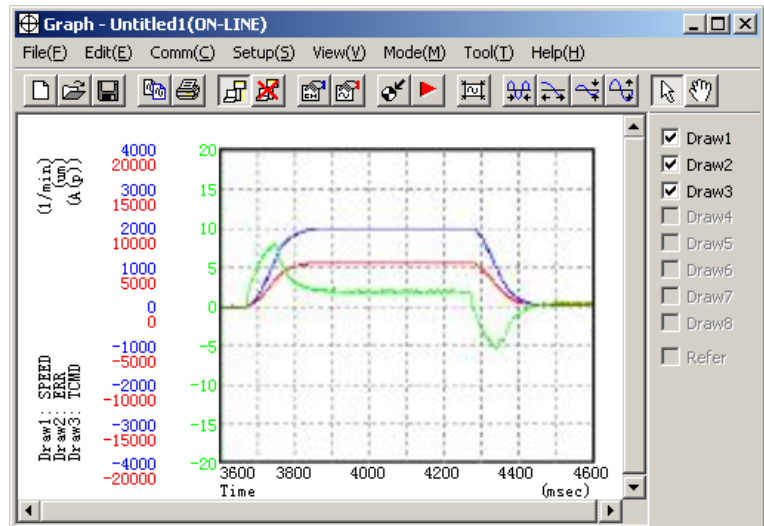
Red: Error

Green: Torque command

5. By the following button, the waveform is zoomed in or out suitably.



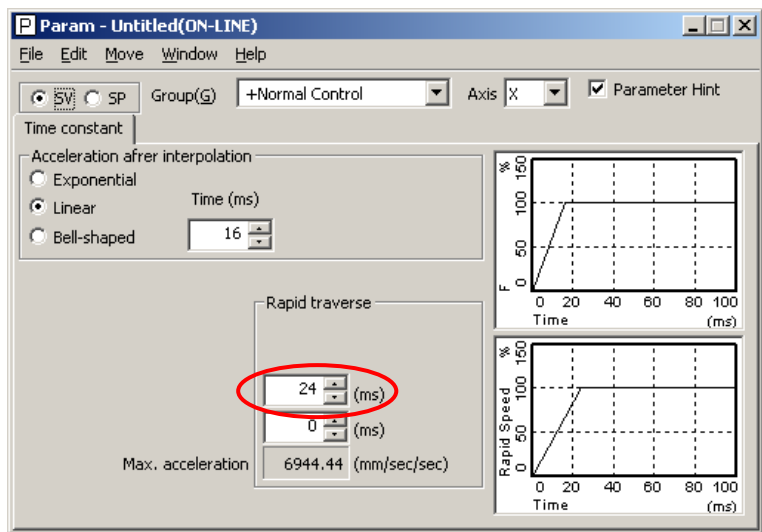
You can see the waveform for example following one.




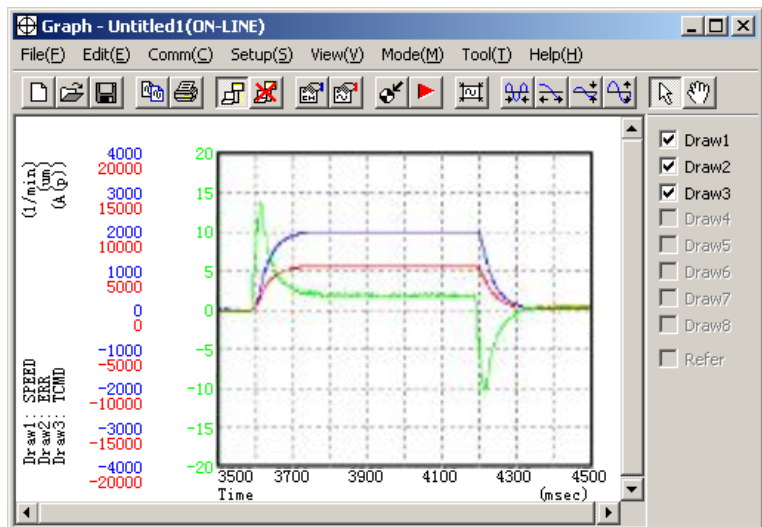
1.1.4 Tuning of Parameters

The parameters are tuned with considering the result of measurement. It is shown to tune time constant on rapid traverse.

1. The first procedure is to open the Parameter Window in ONLINE state.
2. The second procedure is to select [Acc/Dcc and normal control] in combo box of selection function.
3. The third procedure is to set time constant smaller on rapid feed.



4. The fourth procedure is to measure the data again. If you press the [Channel setting] button  and change [Auto scale] to [disable] before measurement, you can compare to the previous data more easily.



For smaller time constant, you have bigger torque command, you can see that speed and error change sharply.

1.2 CONTOUR ERROR TUNING BY CIRCLE PATH MEASUREMENT

You can measure and tune in the following procedure.


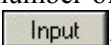

- 1 The first procedure is to make the test program of circle in Program Window.
- 2 The second procedure is to set for measurement in Graph Window.
- 3 The third procedure is to run the program and to measure the data.
- 4 The fourth procedure is to tune the parameter as the need arises.

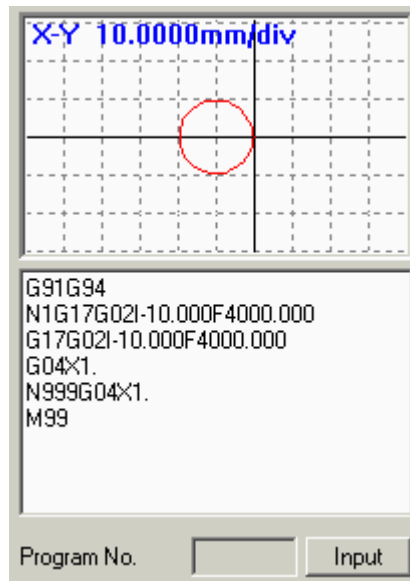
1.2.1 Test Program

In the Program Window, you can make and send the program in the following procedure.

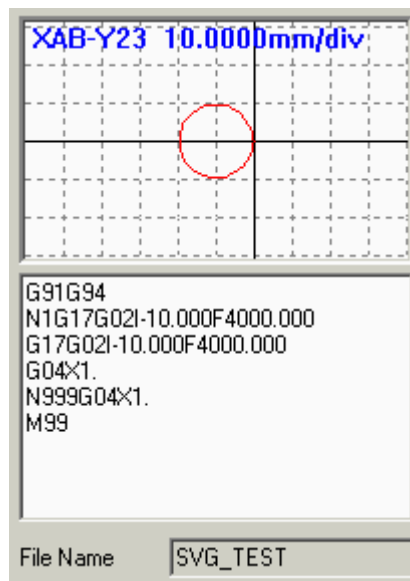
1. The first procedure is to make the program by setting the various condition.

The screenshot shows a dialog box for creating a circle program. The 'Program Mode' is set to 'Circle program'. There is an unchecked checkbox for 'Lathe'. The 'Horiz.-axis' is set to 'X' and the 'Vert.-axis' is set to 'Y'. Under 'Axis Feed', 'Cutting feed' is selected with a radio button, and 'Rapid-traverse' is unselected. The 'G code' section has radio buttons for 'A' and 'B or C', with 'A' selected. The 'Traverse Length' is 10, 'Radius' is 10, 'Feedrate' is 4000, 'Main axis Velocity' is 1000, 'Tapping M code' is M29, 'Repeat' is 2, and 'Start Position' is 30. The 'High Precision Control Mode' is set to 'Advance'. There is an unchecked checkbox for 'use High Speed HRV Current Control'. The 'N (sequence number) for Trigger' is 1. There are 'Apply', 'Cancel', and 'Input' buttons.



2. Decide the program by pressing the <Apply> button . At the time of the FS16i connection, the number of the program is decided by pressing the <Input> button . At the time of the FS30i connection, the name of the program is decided by pressing the <File> button .



→ FS16i




→ FS30i

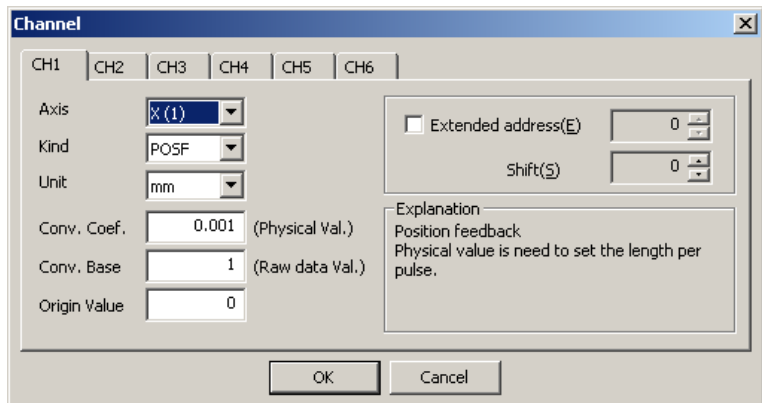
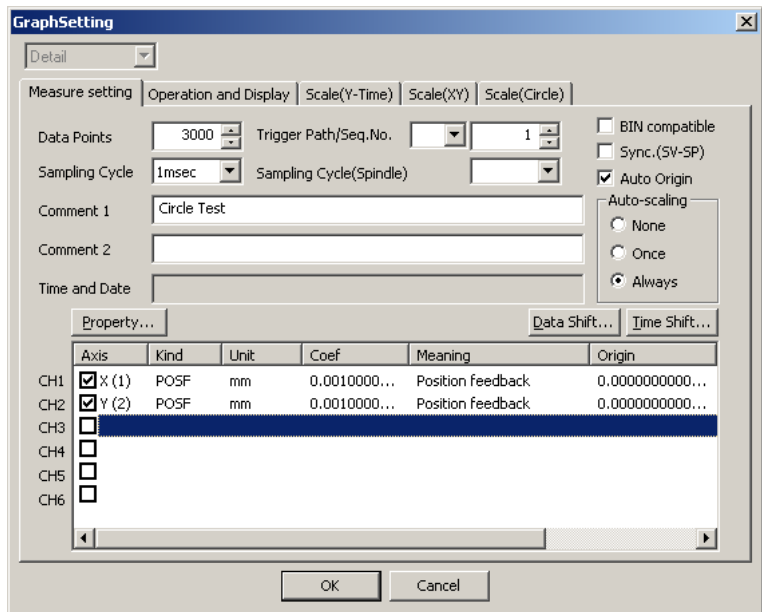
- * It is necessary to confirm the program code that SERVO GUIDE makes.
If you want to modify the program and add the code for example M code, you can edit the program text directly.
- 3. The third procedure is to press the [Sub-program transmission] button , the [Main-program transmission] button .
- 4. The fourth procedure is to press the Cycle start button of machine. It is necessary to confirm that the path of program is correct.

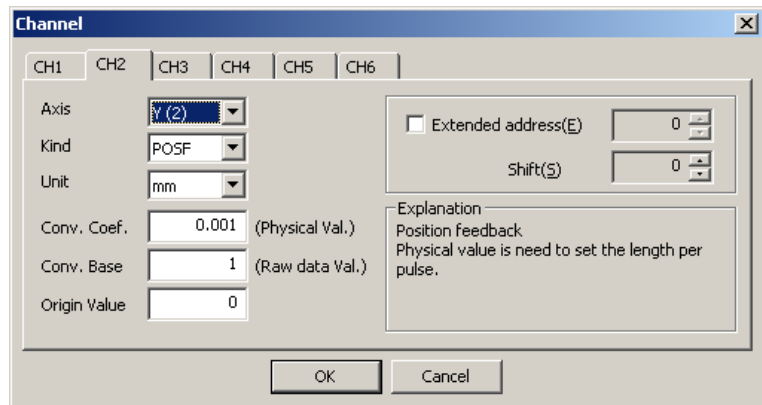
That's all for preparation in Program Window.

1.2.2 Preparation for Measurement


It is necessary to prepare the Graph Window setting in the following procedure.

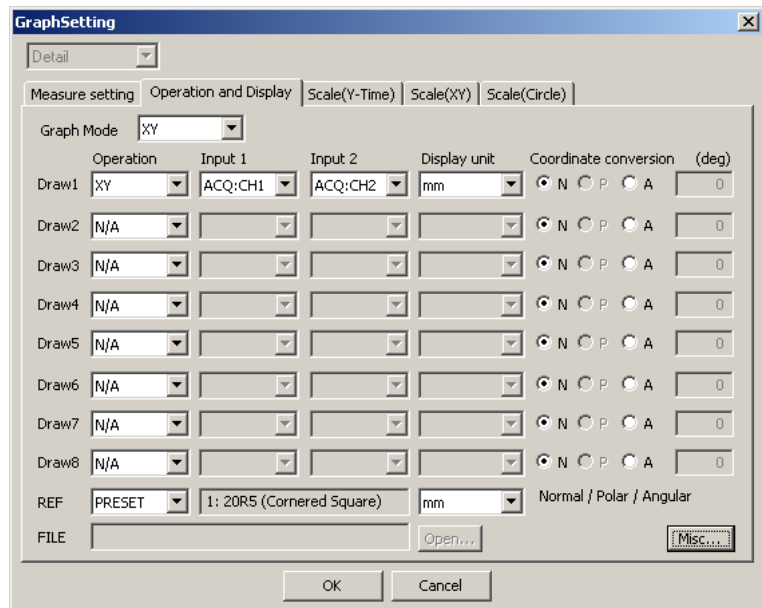
1. The first procedure is to press the [Channel setting] button  and to set the graph display setting. The sample is shown for reference.





In this setting, the position feedback integral value is displayed to CH1, CH2.

2. The second procedure is to change XY mode by pressing the [Ctrl]+[X] after returning the Graph Window.
3. The third procedure is to set the display setting after pressing the [Calculation display] button . The sample is shown for reference.







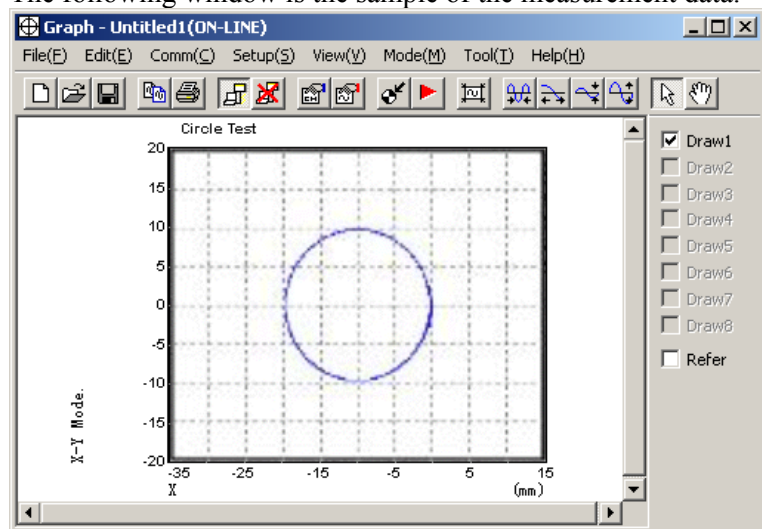
In this window, the display is set as to display XY mode with the data (CH1, CH2) in Draw1.

4. Returning main window, this setting is terminated.


1.2.3 Measurement

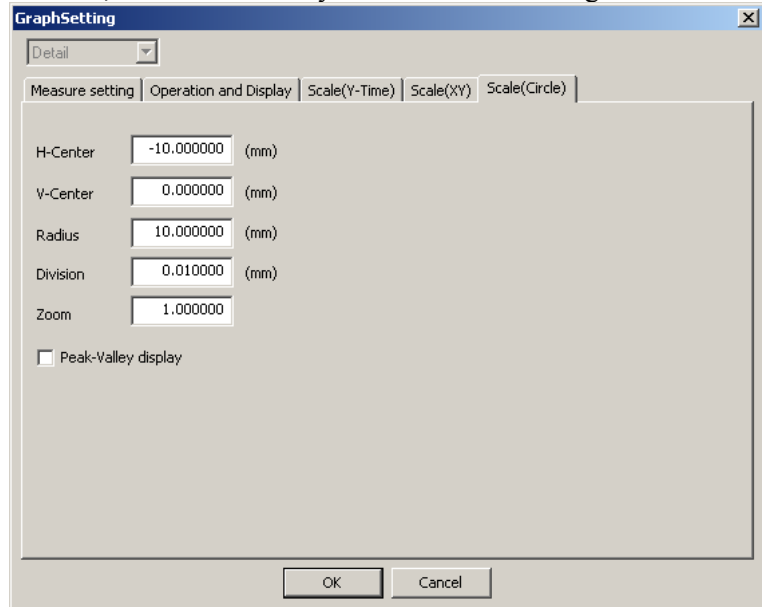
You can measure the data in the following procedure.

1. The first procedure is to press [Origin] button  at one time in Graph Window.
In case that you set trigger, press the [Measurement start] button , too. (The mode changes to trigger waiting mode.)
2. The second procedure is to press the [Main program transmission] button  in Program Window.
3. The third procedure is to run the program by the pressing the Cycle start button of machine.
In case that you set the trigger, the data measurement starts at the same time in Graph Window.
In case that you don't set the trigger, press the [Measurement start] button .
4. The following window is the sample of the measurement data.

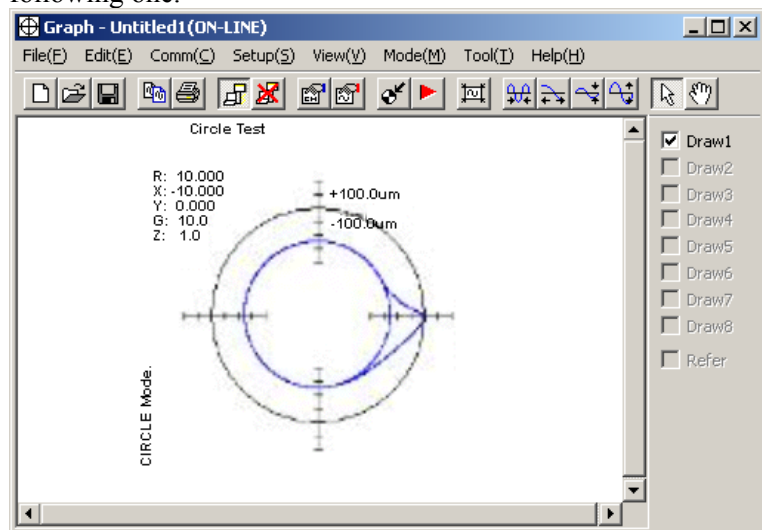


5. To display the contour error of circle shape, it is necessary to change Circle mode with pressing [Ctrl]+[B].

6. After pressing the [Calculation display] button , and selecting the [Scale(circle)] tab. You can see the following window, and it is necessary to set as the following.



7. To return to Graph Window mode, you can see the waveform as following one.



In the window, you can see the radius decreases because the setting is that position gain $30(\text{s}^{-1})$ and no feedforward.

1.2.4 Tuning of Parameters

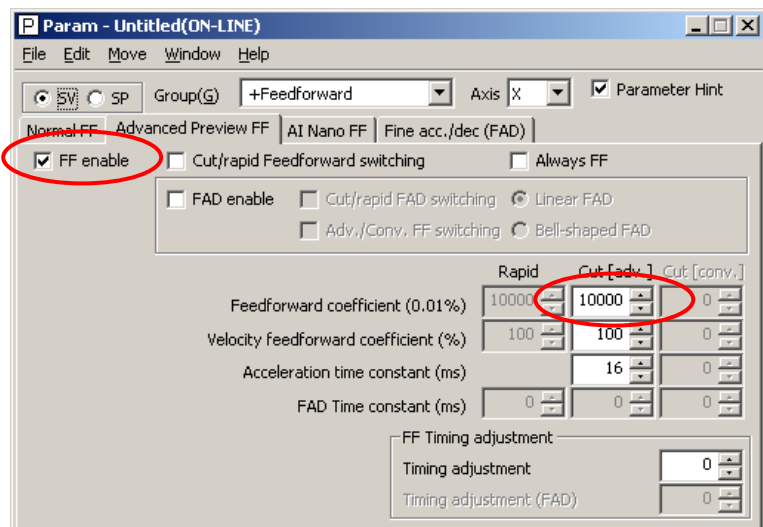
The parameters are tuned with considering the result of measurement. It is shown to tune feedforward coefficient.

1. The first procedure is to open the Parameter Window in ONLINE state.
2. The second procedure is to select the [Contour error of arbitrary shape + feedforward] in the function select combo box and to select the [Advanced preview FF].
(In the sample program, the advanced preview control is used.)
3. It is useful to select the [Open the different window with the same parameter] in [Window] menu, because you can set the plural axes at the same time with setting the parameter in one window.

NOTE

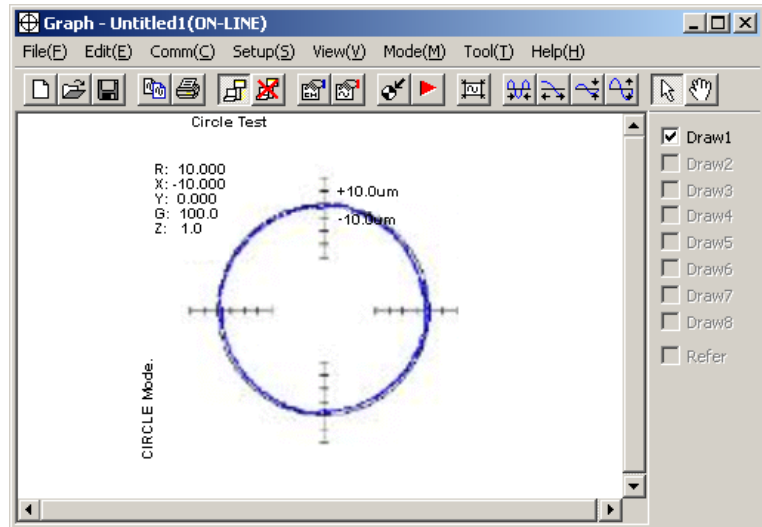
In case of using the Windows98/Me, the resource shortage may occur, or the display may not be described correctly. When case occurred, don't open the two window.

4. In the following window, feed-forward function is enable and feed-forward coefficient is set to 100%.



- * Set both the X axis and Y axis.

5. The fifth procedure is to measure the data again.
In this time, the getting error is lower, and zoom up the graph with pressing the “U(up)” key.



1.3 CIRCLE MEASUREMENT FOR AN ANGULAR AXIS

You can measure in the following procedure.

- 1 The first procedure is to make the test program of circle in Program Window.
- 2 The second procedure is to set for measurement in Graph Window.
- 3 The third procedure is to run the program and to measure the data.

1.3.1 Test Program

In the Program Window, you can make and send the program in the following procedure.

1. The first procedure is to make the program by setting the various condition.

Program Mode: Circle program Lathe

Horiz.-axis: X Vert.-axis: Y G code: A B or C

Axis Feed: Cutting feed Rapid-traverse

Traverse Length: 10 Radius: 10

Feedrate: 4000 Main axis Velocity: 1000

Tapping M code: M29 Repeat: 2

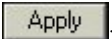
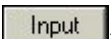

Start Position: 30

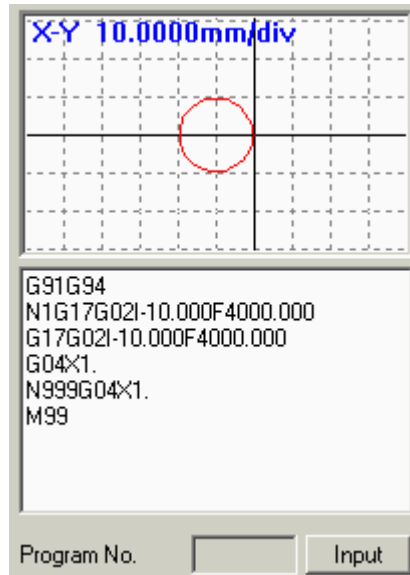
High Precision Control Mode: Advance

use High Speed HRV Current Control

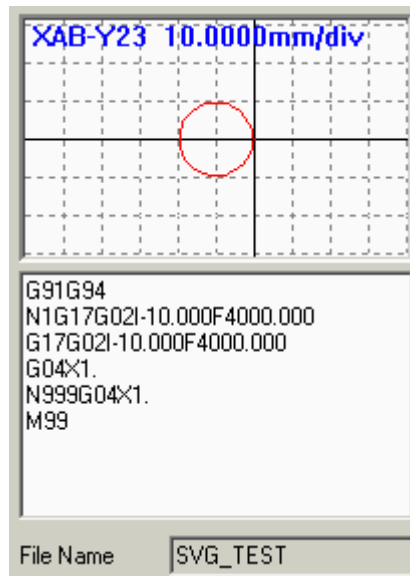
N (sequence number) for Trigger: 1

Buttons: Cancel, Apply



2. Decide the program by pressing the <Apply> button .
At the time of the FS16i connection, the number of the program is decided by pressing the <Input> button .
At the time of the FS30i connection, the name of the program is decided by pressing the <File> button .



→ FS16i



→ FS30i


- * It is necessary to confirm the program code that SERVO GUIDE makes. If you want to modify the program and add the code for example M code, you can edit the program text directly.
3. The third procedure is to press the [Sub-program transmission] button , the [Main-program transmission] button .

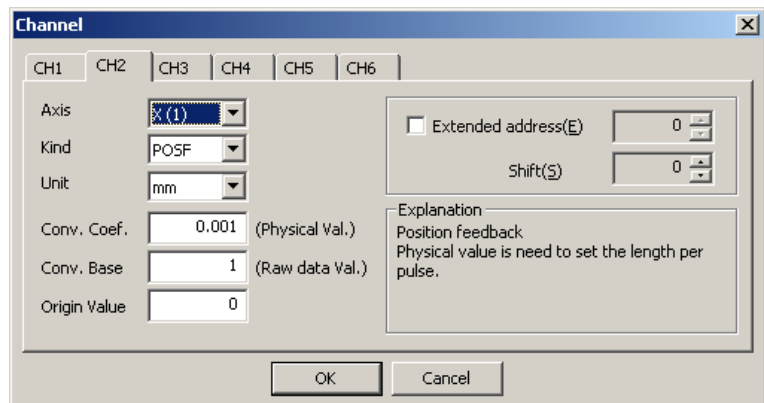
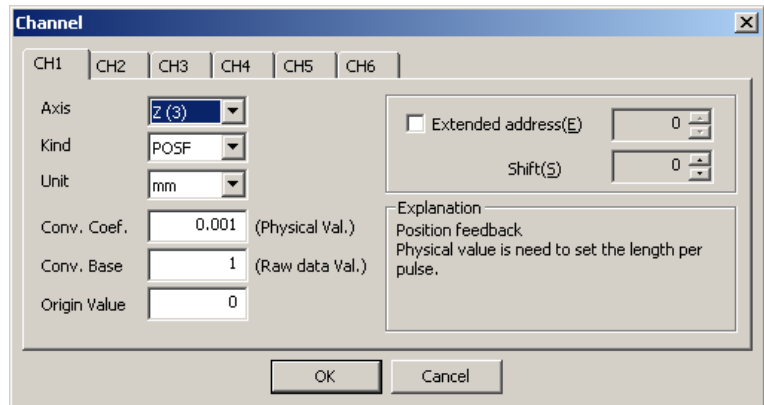
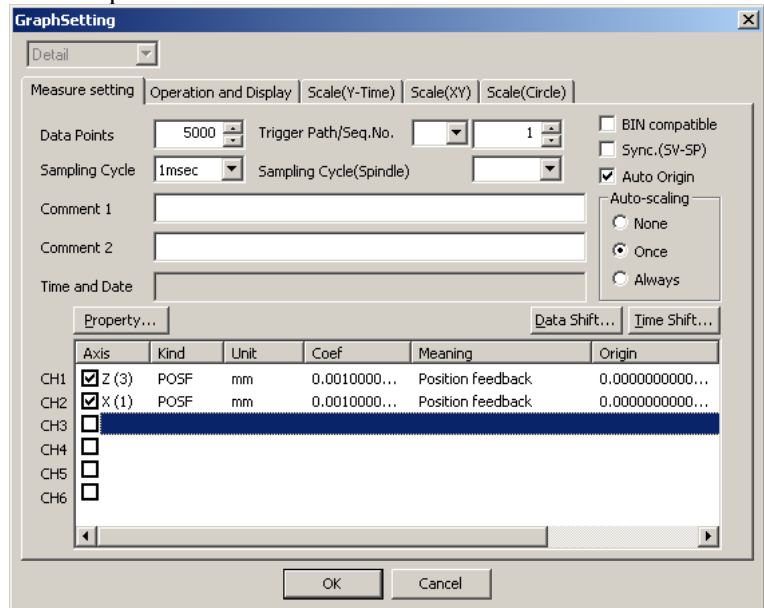
4. The fourth procedure is to press the Cycle start button of machine. It is necessary to confirm that the path of program is correct.

That's for preparation in Program Window.


1.3.2 Preparation for Measurement

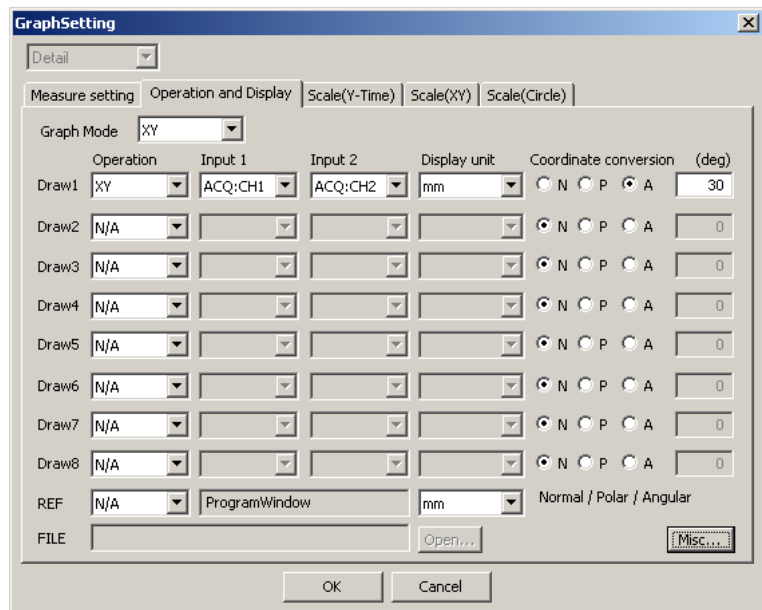
It is necessary to prepare the Graph Window setting in the following procedure.

1. The first procedure is to press the [Channel setting] button  and to set the graph display setting. The sample is shown for reference.



CH1 and CH2 are set so that position feedback integral values are output on CH1 and CH2.

2. The second procedure is to change XY mode by pressing the [Ctrl]+[X] after returning the Graph Window.
3. The third procedure is to set the display setting after pressing the [Calculation display] button . The sample is shown for reference.







In this window, the display is set as to display XY mode with the data (CH1, CH2) in Draw1.

Set perpendicular axis as Input 1 and angular axis as Input 2. And select "A: Angular axis" as Coordinate conversion and set the degree of the angle beside it.

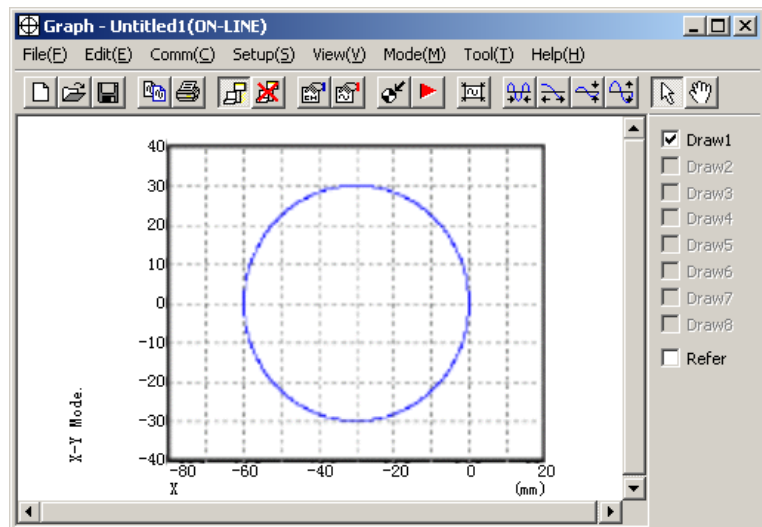
4. Returning main window, this setting is terminated.

1.3.3 Measurement

You can measure the data in the following procedure.

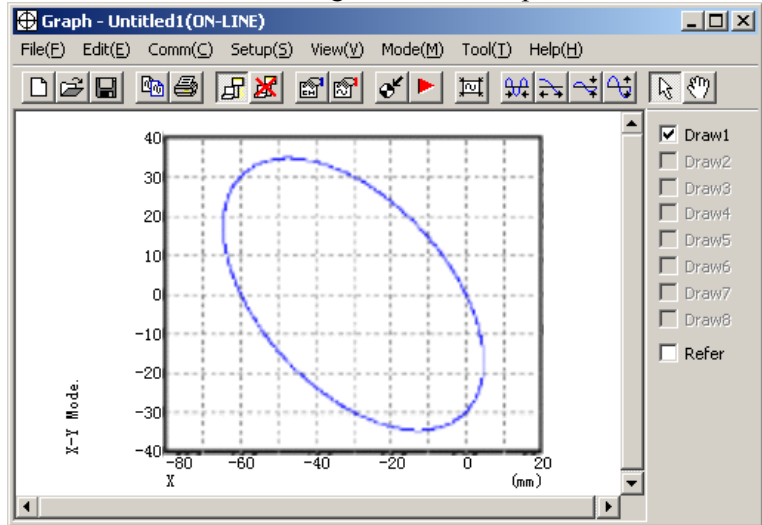
1. The first procedure is to press [Origin] button  at one time in Graph Window.
In case that you set trigger, press the [Measurement start] button , too. (The mode changes to trigger waiting mode.)
2. The second procedure is to press the [Main program transmission] button  in Program Window.
3. The third procedure is to run the program by the pressing the Cycle start button of machine.
In case that you set the trigger, the data measurement starts at the same time in Graph Window.
In case that you don't set the trigger, press the [Measurement start] button .
4. The following window is the sample of the measurement data.

After conversion from Angular axis to Perpendicular axis

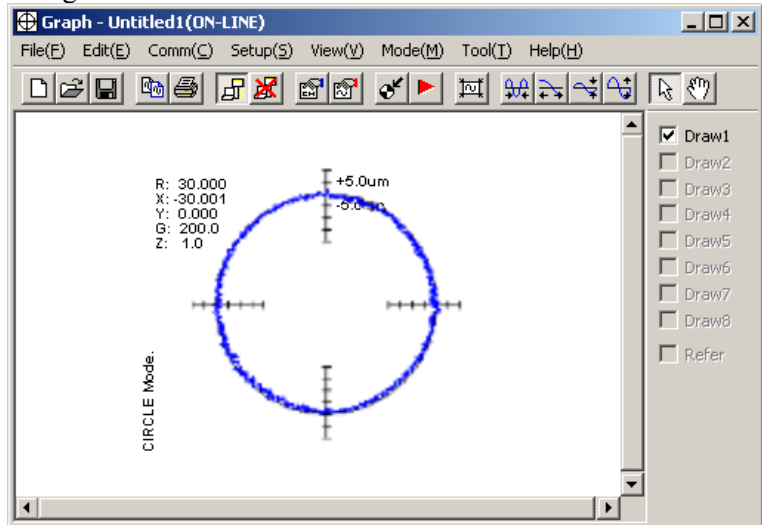


When you press [Ctrl]+[R], the angular conversion will be switched as toggle.

Before conversion from Angular axis to Perpendicular axis



5. You can use Circle mode against the waveform which is converted from Angular to Perpendicular. Press [Ctrl]+[B] to change to Circle mode.



1.4 TUNING OF OVERSHOOTS BY MEASURING A SQUARE PATH

You can measure and tune in the following procedure.

- 1 The first procedure is to make the test program of square in Program Window.
- 2 The second procedure is to set for measurement in Graph Window.
- 3 The third procedure is to run the program and to measure the data.
- 4 The fourth procedure is to tune the parameter as the need arises.

1.4.1 Test Program

In the Program Window, you can make and send the program in the following procedure.

1. The first procedure is to make the program by setting the various condition.

Program Mode: Square program Lathe

Horiz.-axis: X Vert.-axis: Y G code: A B or C

Axis Feed: Cutting feed Rapid-traverse

Side Length: 20 Radius: 10

Feedrate: 4000 Main axis Velocity: 1000

Tapping M code: M29 Repeat: 1

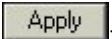
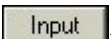

Start Position: 30

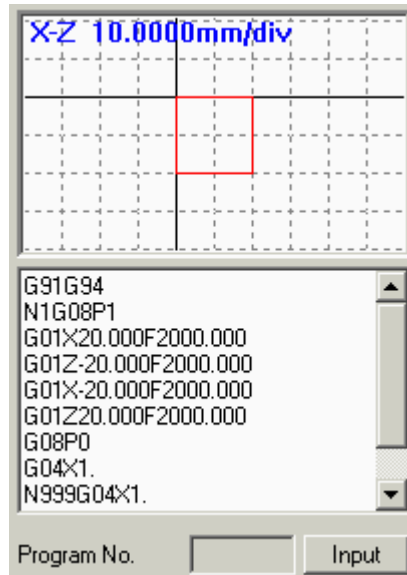
High Precision Control Mode: Advance

use High Speed HRV Current Control

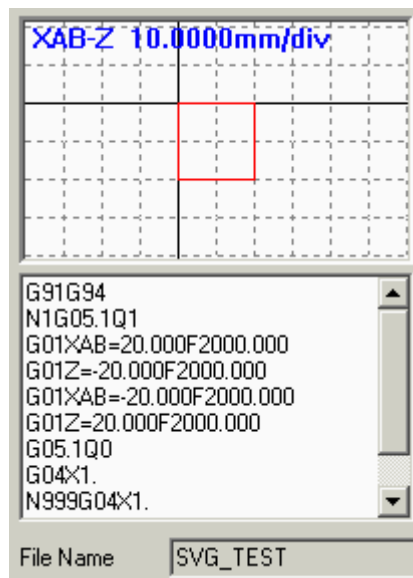
N (sequence number) for Trigger: 1

Buttons: Cancel, Apply



2. Decide the program by pressing the <Apply> button .
At the time of the FS16i connection, the number of the program is decided by pressing the <Input> button .
At the time of the FS30i connection, the name of the program is decided by pressing the <File> button .



→ FS16i



→ FS30i


- * It is necessary to confirm the program code that SERVO GUIDE makes.
If you want to modify the program and add the code for example M code, you can edit the program text directly.
3. The third procedure is to press the [Sub-program transmission] button , the [Main-program transmission] button .

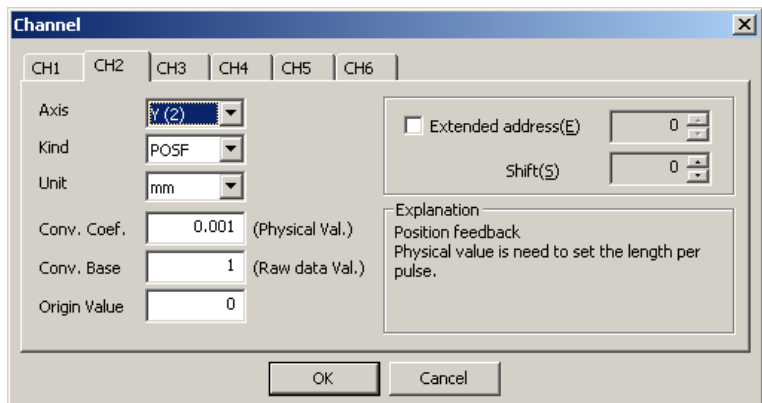
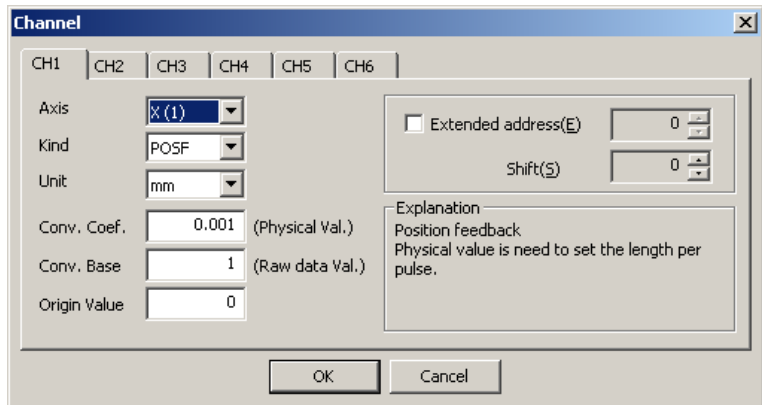
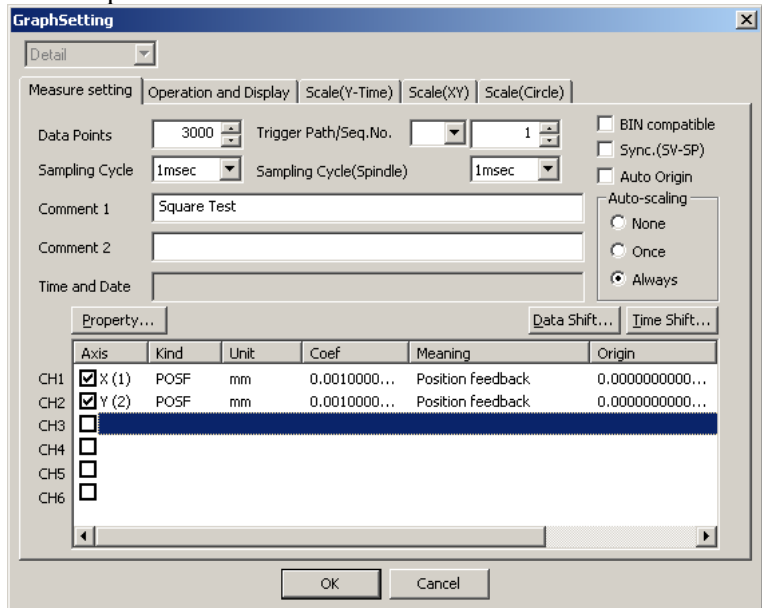
4. The fourth procedure is to press the Cycle start button of machine. It is necessary to confirm that the path of program is correct.

That's all for preparation in Program Window.


1.4.2 Preparation for Measurement

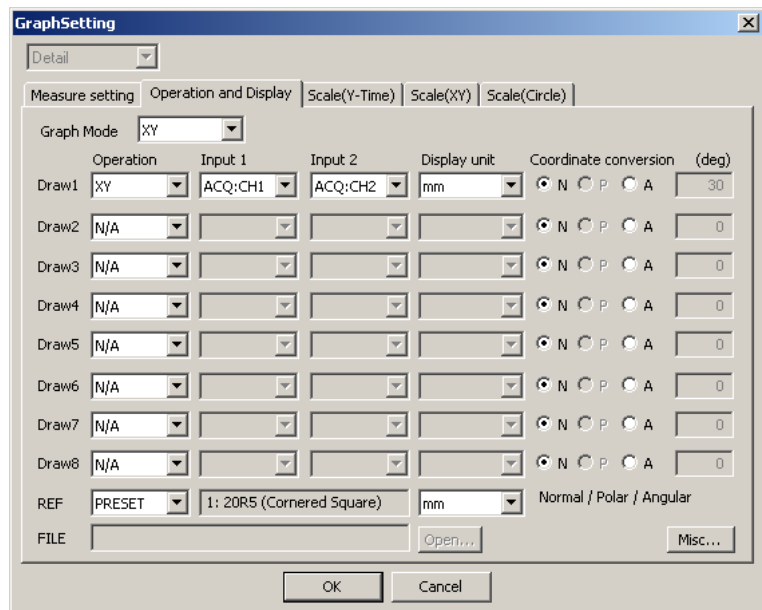
It is necessary to prepare the Graph Window setting in the following procedure.

1. The first procedure is to press the [Channel setting] button  and to set the graph display setting. The sample is shown for reference.



In upper window, the position feedback integral value is outputted to CH1, 2.

2. The second procedure is to change XY mode by pressing the [Ctrl]+[X] after returning the Graph Window.
3. The third procedure is to set the display setting after pressing the [Calculation display] button . The sample is shown for reference.







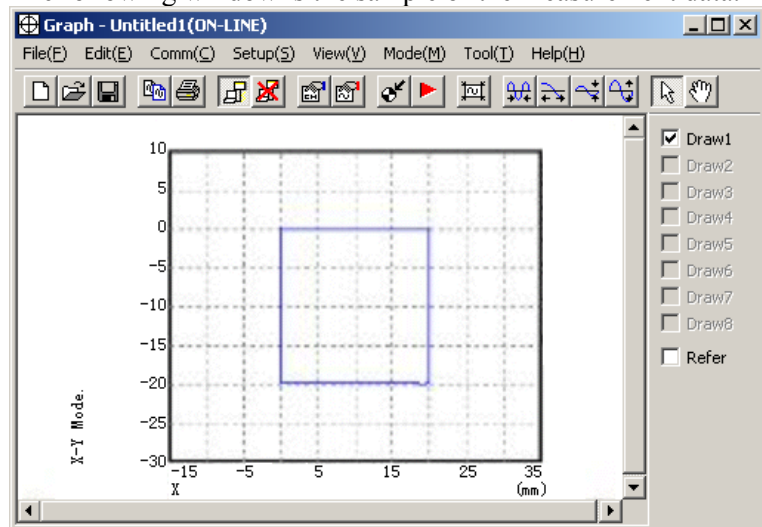
In this window, the display is set as to display XY mode with the data (CH1, CH2) in Draw1.

4. Returning main window, this setting is terminated.

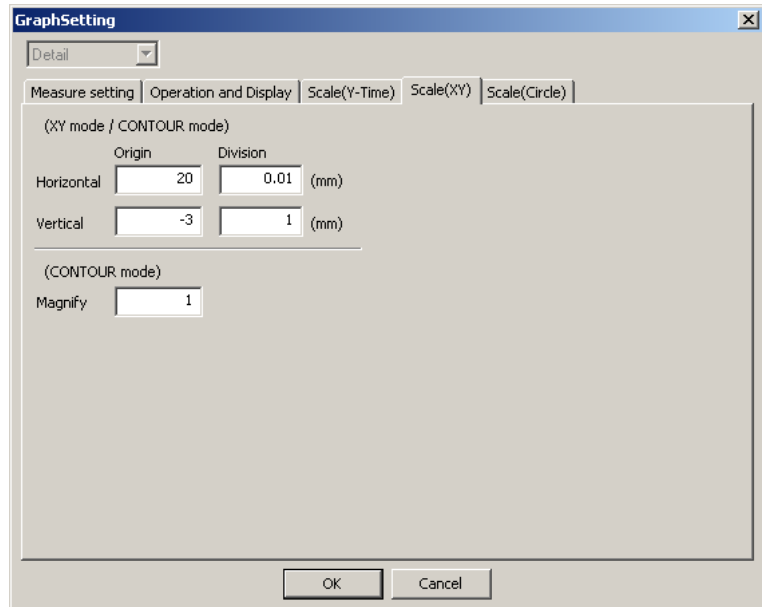
1.4.3 Measurement

You can measure the data in the following procedure.

1. The first procedure is to press [Origin] button  at one time in Graph Window.
In case that you set trigger, press the [Measurement start] button , too. (The mode changes to trigger waiting mode.)
2. The second procedure is to press the [Main program transmission] button  in Program Window.
3. The third procedure is to run the program by the pressing the Cycle start button of machine.
In case that you set the trigger, the data measurement starts at the same time in Graph Window.
In case that you don't set the trigger, press the [Measurement start] button .
4. The following window is the sample of the measurement data.

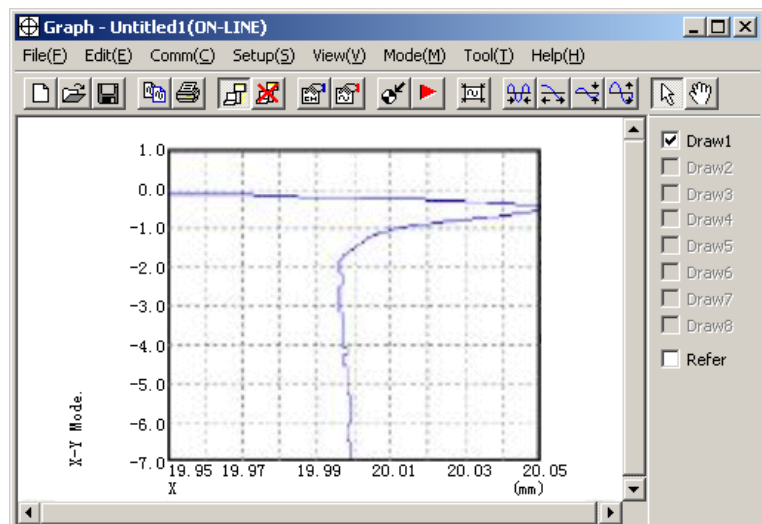


5. The display range is changed to observe the overshoot at the upper right.
You can change the scale setting with the [F3] button.



In upper sample, the center of abscissa axis is changed to 20, one division is changed to 0.01 mm, the center of ordinate axis is changed to -3, one division is changed to 1mm.

6. Turning to the graph window, you can see the corner of the previous square in detail.

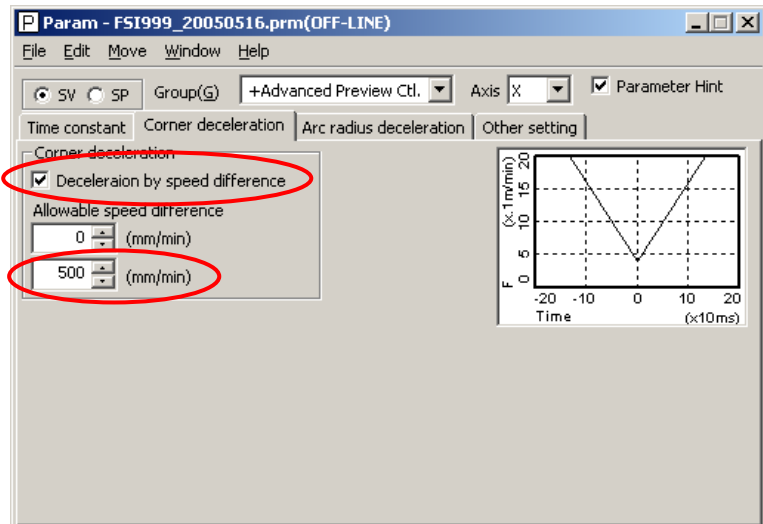


In this sample, you see that the occurred overshoot is about 50 μm .


1.4.4 Tuning of Parameters

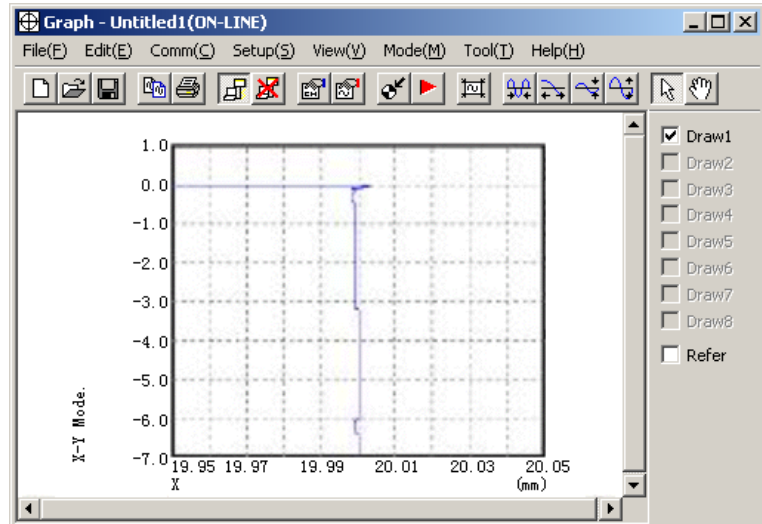
The parameters are tuned with considering the result of measurement. It is shown to tune the Automatic corner deceleration.

1. The first procedure is to open the Parameter Window in ONLINE state.
2. The second procedure is to select the [Acceleration + Advanced Preview Control] in the combo box on function select and to select the [Corner deceleration] tab.
(In the sample program, the advanced preview control is used.)
3. The third procedure is to check the [Corner deceleration with velocity difference] and to set the parameter of the allowed velocity difference.



- * These parameters are common values among all axes. It is not necessary to set each axis.

4. The fifth procedure is to measure the data again.
If you press the [Channel setting] button  and change [Auto scale] to [disable] before measurement, you can compare to the previous data more easily.



You can see that the overshoot is lower by the function Automatic corner deceleration.

1.5 TUNING OF OVERSHOOTS BY MEASURING A SQUARE PATH WITH ROUNDED CORNERS

You can measure and tune in the following procedure.

- 1 The first procedure is to make the test program of square with 1/4 arc in Program Window.
- 2 The second procedure is to set for measurement in Graph Window.
- 3 The third procedure is to run the program and to measure the data.
- 4 The fourth procedure is to tune the parameter as the need arises.

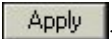
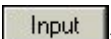

1.5.1 Test Program

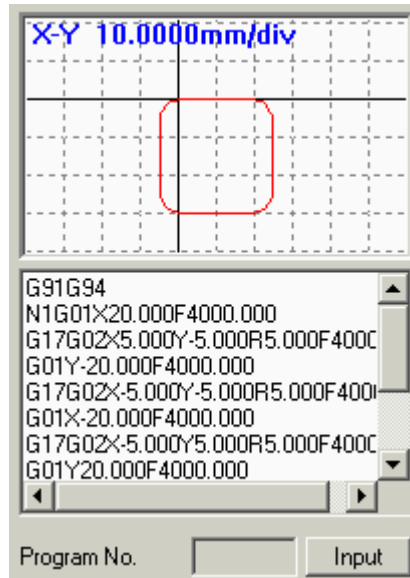
In the Program Window, you can make and send the program in the following procedure.

1. The first procedure is to make the program by setting the various condition.

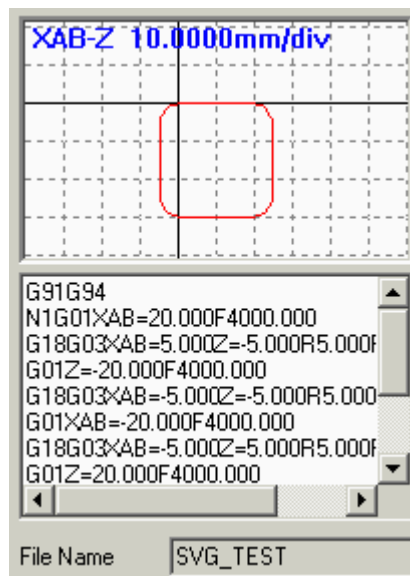
The screenshot shows a dialog box for configuring a CNC program. The 'Program Mode' is set to 'Square with 1/4Arc'. The 'Lathe' checkbox is unchecked. The 'Horiz.-axis' is set to 'X' and the 'Vert.-axis' is set to 'Y'. The 'Axis Feed' section has 'Cutting feed' selected. The 'G code' section has 'A' selected. The 'Side' is 20, 'Radius' is 5, 'Length' is 4000, 'Feedrate' is 4000, 'Tapping M code' is M29, 'Main axis Velocity' is 1000, 'Repeat' is 1, and 'Start Positon' is 30. The 'High Precision Control Mode' is set to 'Advance'. The 'use High Speed HRV Current Control' checkbox is unchecked. The 'N (sequence number) for Trigger' is 1. There are 'Cancel' and 'Apply' buttons.

Program Mode	Square with 1/4Arc	<input type="checkbox"/> Lathe				
Horiz.-axis	X	Vert.-axis	Y	G code	<input type="radio"/> A	
Axis Feed	<input checked="" type="radio"/> Cutting feed	<input type="radio"/> Rapid-traverse	<input type="radio"/> B or C			
Side	20	Radius	5			
Length	4000	Main axis Velocity	1000			
Feedrate	4000	Repeat	1			
Tapping M code	M29	Start Positon	30			
High Precision Control Mode	Advance					
<input type="checkbox"/> use High Speed HRV Current Control					Cancel	
N (sequence number) for Trigger	1					Apply



2. Decide the program by pressing the <Apply> button .
 At the time of the FS16i connection, the number of the program is decided by pressing the <Input> button .
 At the time of the FS30i connection, the name of the program is decided by pressing the <File> button .



→ FS16i



→ FS30i


- * It is necessary to confirm the program code that SERVO GUIDE makes.
 If you want to modify the program and add the code for example M code, you can edit the program text directly.
3. The third procedure is to press the [Sub-program transmission] button , the [Main-program transmission] button .

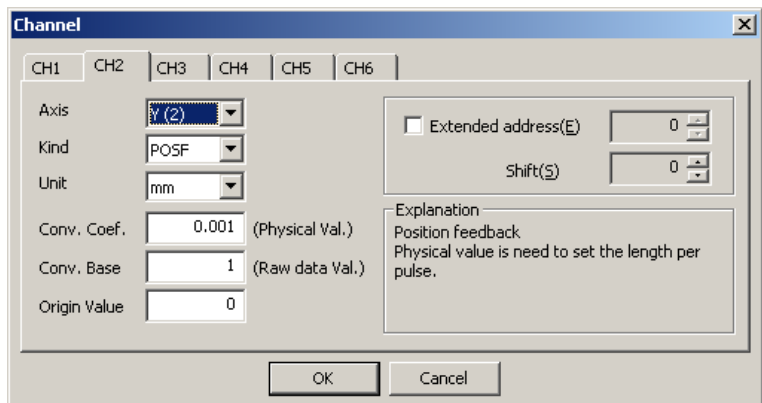
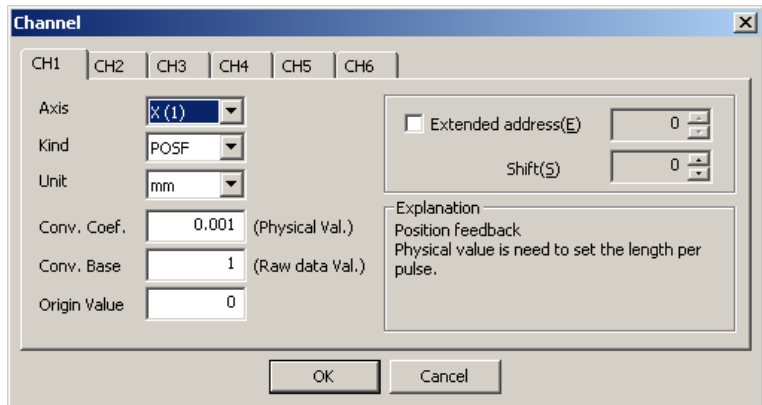
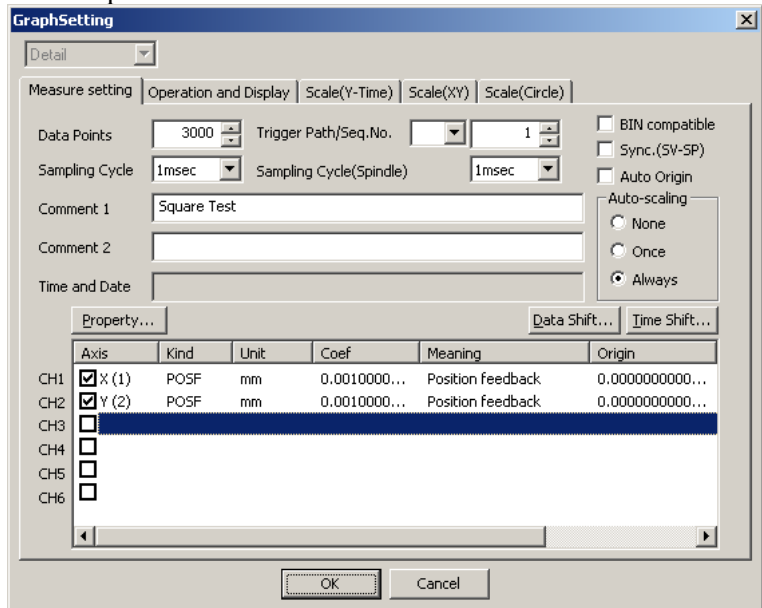
4. The fourth procedure is to press the Cycle start button of machine. It is necessary to confirm that the path of program is correct.

That's all for preparation in Program Window.


1.5.2 Preparation for Measurement

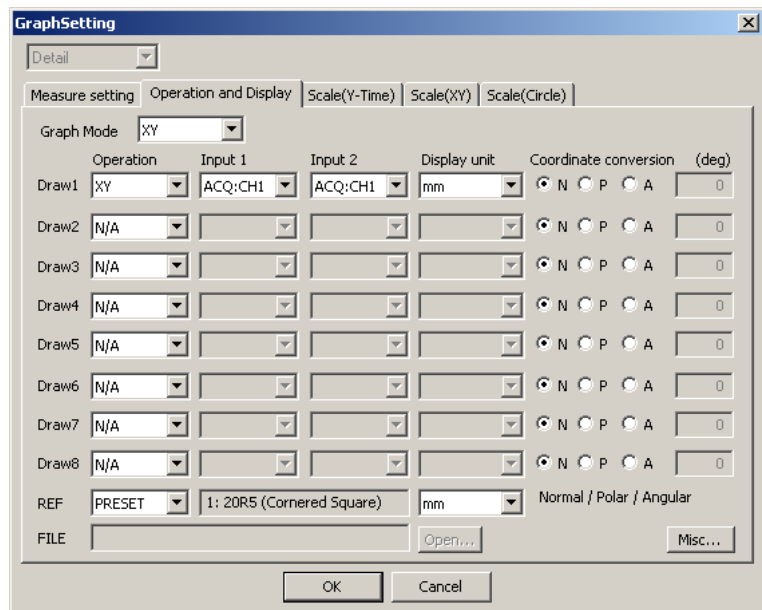
It is necessary to prepare the Graph Window setting in the following procedure.

1. The first procedure is to press the [Channel setting] button  and to set the graph display setting. The sample is shown for reference.



In this window, the position feedback integral value is outputted to CH1, 2.

2. The second procedure is to change XY mode by pressing the [Ctrl]+[X] after returning the Graph Window.
3. The third procedure is to set the display setting after pressing the [Calculation display] button . The sample is shown for reference.







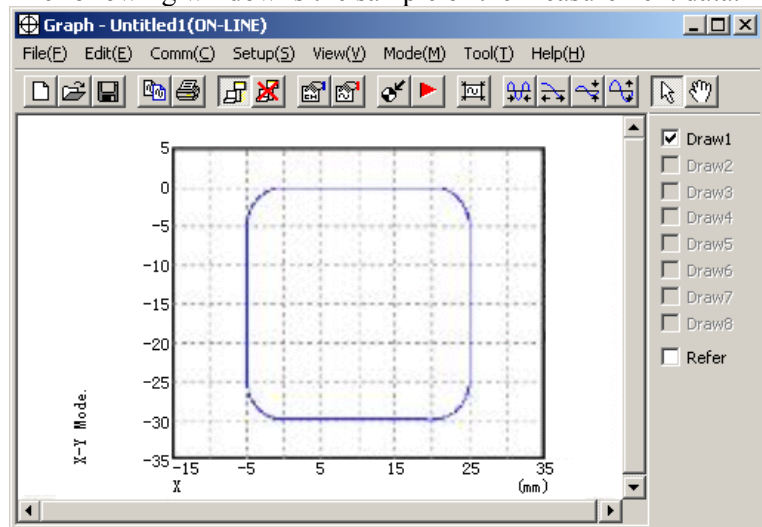
In this window, the display is set as to display XY mode with the data (CH1, CH2) in Draw1.

4. Returning main window, this setting is terminated.

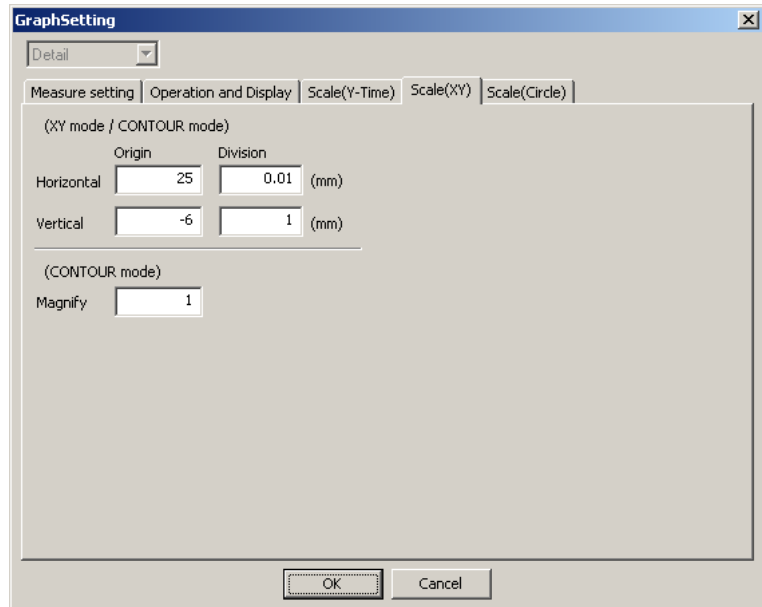
1.5.3 Measurement

You can measure the data in the following procedure.

1. The first procedure is to press [Origin] button  at one time in Graph Window.
In case that you set trigger, press the [Measurement start] button , too. (The mode changes to trigger waiting mode.)
2. The second procedure is to press the [Main program transmission] button  in Program Window.
3. The third procedure is to run the program by the pressing the Cycle start button of machine.
In case that you set the trigger, the data measurement starts at the same time in Graph Window.
In case that you don't set the trigger, press the [Measurement start] button .
4. The following window is the sample of the measurement data.

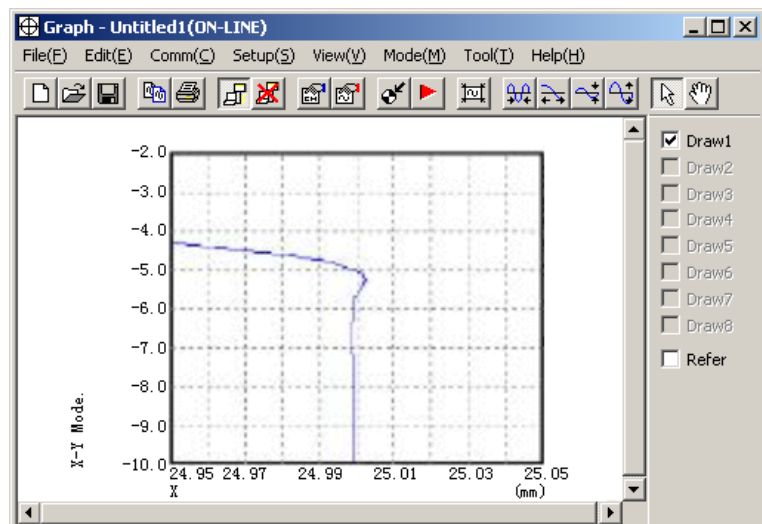


5. The display range is changed to observe the overshoot at the upper right.
You can change the scale setting with the [F3] button.



In upper sample, the center of abscissa axis is changed to 25, one division is changed to 0.01 mm, the center of ordinate axis is changed to -6, one division is changed to 1mm.

Turning to the Graph Window, you can see the corner of the previous square in detail.



In this sample, you see that the occurred overshoot is about 3 μm .

Reference)

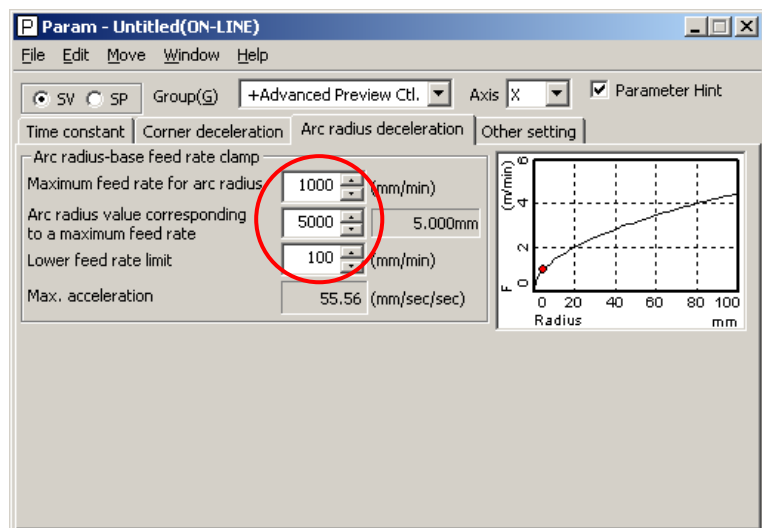
The reference path is prepared in case that you select the [Square with 1/4 arc], the program path (length = 20 mm and radius of corner = 5 mm), in the Program Window.

If you can select [PRESET] at [PEF] in [Calculation and display setting], you can use the reference path, In the wave display ON/OFF panel, use on Contour mode etc with Refer checked.


1.5.4 Tuning of Parameters

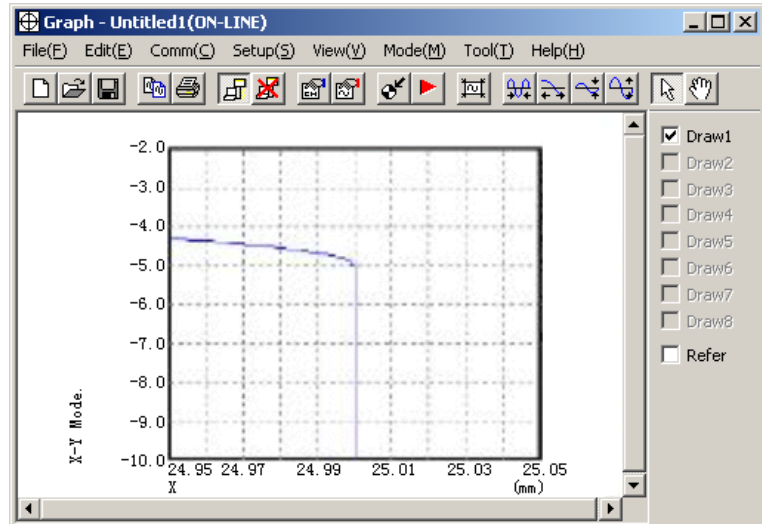
The parameters are tuned with considering the result of measurement. It is shown to tune velocity clamp by circle radius.

1. The first procedure is to open the Parameter Window in ONLINE state.
2. The second procedure is to select the [Acceleration + Advanced Preview Control] in the combo box on function select and to select the [Arc radius deceleration] tab.
(In the sample program, the advanced preview control is used.)
3. In the following window, it is shown to set the parameter.



- * These parameters are common values among all axes. It is not necessary to set each axis.

4. The fourth procedure is to measure the data again. If you press the [Channel setting] button  and change [Auto scale] to [disable] before measurement, you can compare to the previous data more easily.



You can see that the overshoot become less by the function Automatic deceleration.

1.6 TUNING OF RIGID TAPPING SYNCHRONOUS ERROR

You can measure and tune in the following procedure.

- 1 The first procedure is to prepare the NC parameter.
- 2 The second procedure is to make the test program for rigid tapping in Program Window.
- 3 The third procedure is to set for measurement in Graph Window.
- 4 The fourth procedure is to run the program and to measure the data.
- 5 The fifth procedure is to tune the parameter as the need arises.

1.6.1 Preparation on NC

It is necessary to set the following parameters for output of synchronous error in rigid tapping mode.

	#7	#6	#5	#4	#3	#2	#1	#0
3700			ESV					

- # 5 **ESV** Rigid tapping synchronous errors are:
 0: Not output to the tapping axis.
 1: Output to the tapping axis.

(SERVO GUIDE operation)

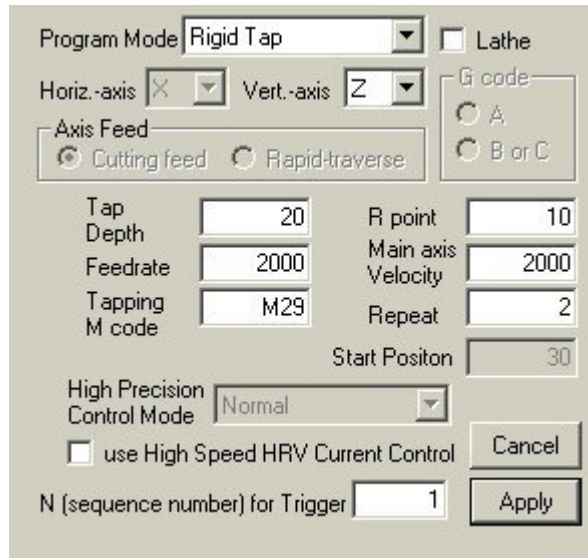
1. The first procedure is to select the [Parameter table] (The last item) at [Function group combo box] in Parameter Window.
2. The second procedure is to jump to the No. 3700 with [Ctrl]+[G].
3. The third procedure is to change the bit parameter as following.




3626	A	<input type="checkbox"/> B7:	0	0
3627	A	<input type="checkbox"/> B6:	0	0
3661	S	<input checked="" type="checkbox"/> B5:	0	<-
3666	S	<input type="checkbox"/> B4:	0	<-
3671	S	<input type="checkbox"/> B3:	0	<-
3676	S	<input type="checkbox"/> B2:	0	<-
3681	S	<input type="checkbox"/> B1:	0	<-
3681	S	<input type="checkbox"/> B0:	0	<-
3700	L	00100000	<-	<-
3701	L	nnnnnnnn	<-	<-

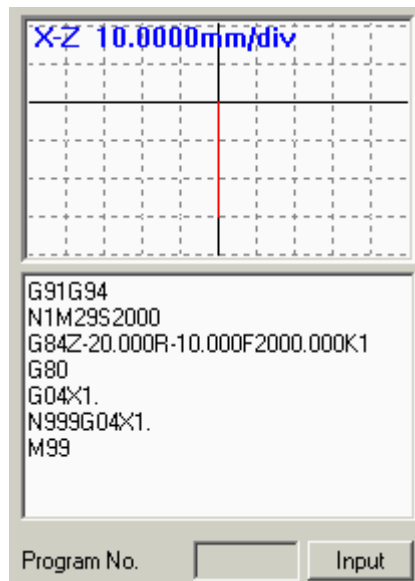
1.6.2 Test Program

In the Program Window, you can make and send the program in the following procedure.

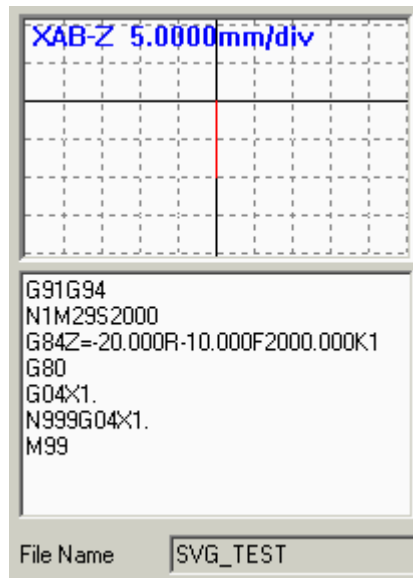
1. The first procedure is to make the program by setting the various condition.





2. Decide the program by pressing the <Apply> button . At the time of the FS16i connection, the number of the program is decided by pressing the <Input> button . At the time of the FS30i connection, the name of the program is decided by pressing the <File> button .



→ FS16i




→ FS30i

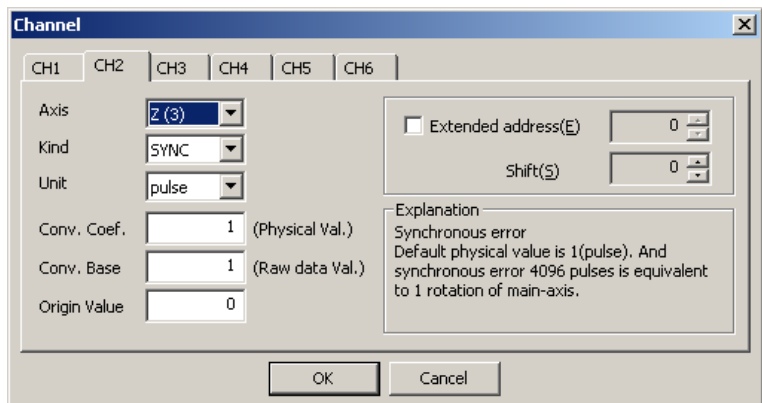
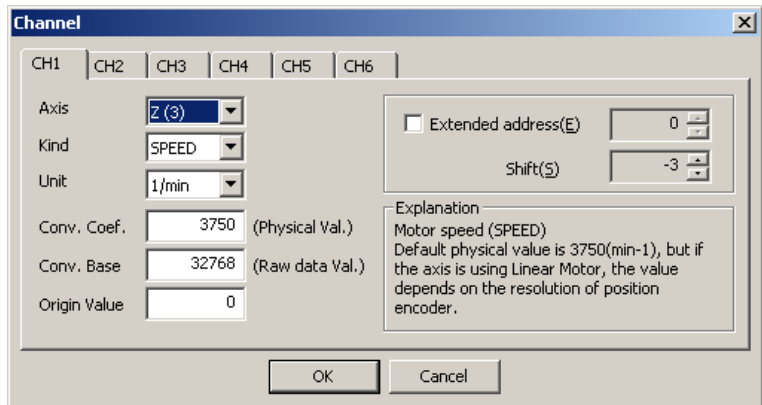
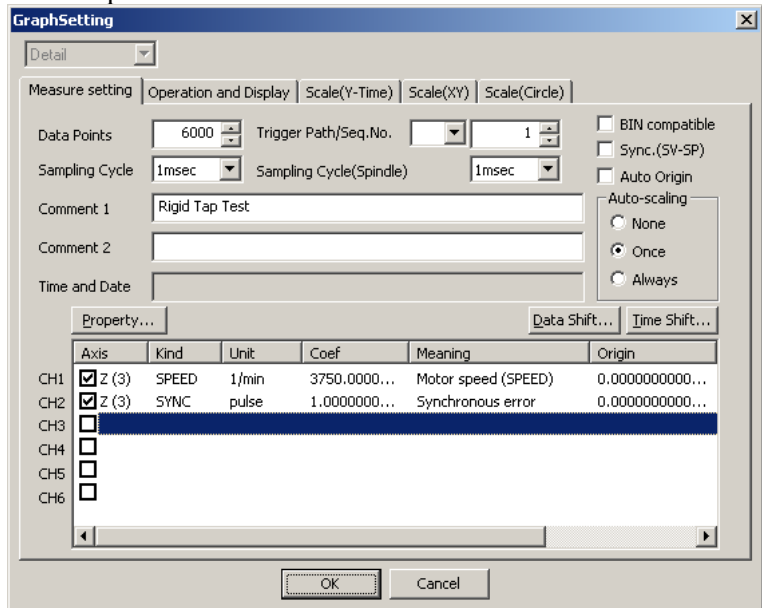
- * It is necessary to confirm the program code that SERVO GUIDE make.
If you want to modify the program and add the code for example M code, you can edit the program text directly.
- 3. The third procedure is to press the [Sub-program transmission] button , the [Main-program transmission] button .
- 4. The fourth procedure is to press the Cycle start button of machine. It is necessary to confirm that the path of program is correct.

That's all for preparation in Program Window.


1.6.3 Preparation for Measurement

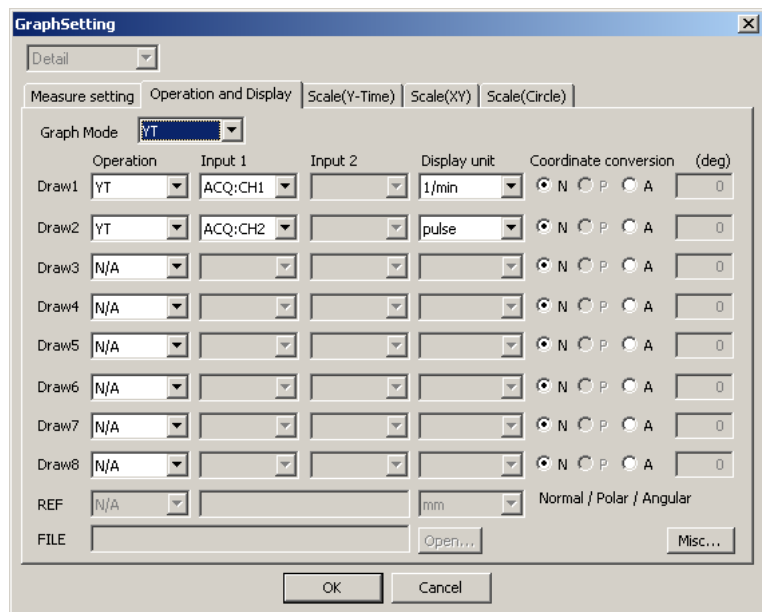
It is necessary to prepare the Graph Window setting in the following procedure.

1. The first procedure is to press the [Channel setting] button  and to set the graph display setting. The sample is shown for reference.



The upper window is set to display the velocity of Z axis in CH1 and the synchronous error of Z axis in CH2.

- * The synchronous error data is output to tapping axis (servo axis).
2. The second procedure is to turn back main of Graph Window, to change Y-T mode by pressing [Ctrl]+[T].
 3. The third procedure is to set the display setting after pressing the [Calculation display] button . The sample is shown for reference.







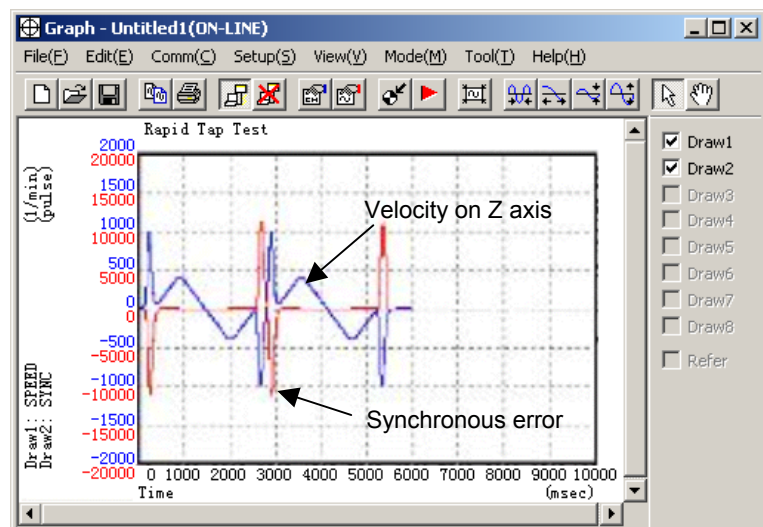
In the above settings, the result of measurement on CH1 is directly output to Draw1, and the result of measurement on CH2 is directly output to Draw2.

4. Returning main window, this setting is terminated.

1.6.4 Measurement



You can measure the data in the following procedure.

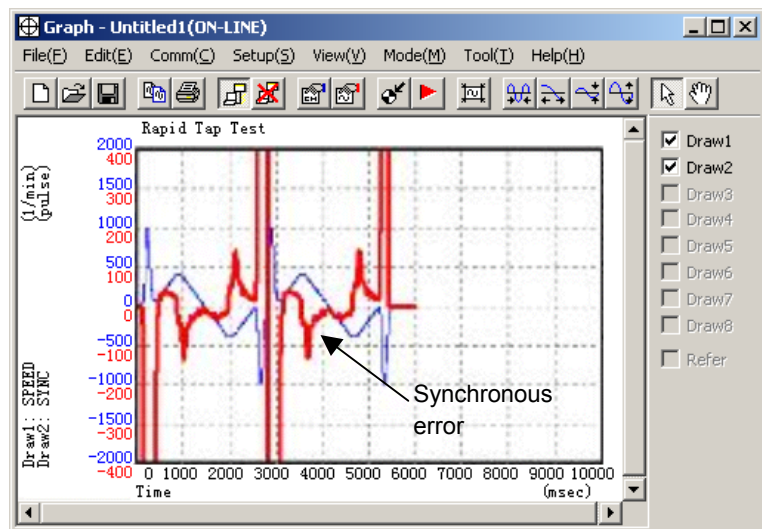
1. The first procedure is to press [Origin] button  at one time in Graph Window.
In case that you set trigger, press the [Measurement start] button , too. (The mode changes to trigger waiting mode.)
2. The second procedure is to press the [Main program transmission] button  in Program Window.
3. The third procedure is to run the program by the pressing the Cycle start button of machine.
In case that you set the trigger, the data measurement starts at the same time in Graph Window.
In case that you don't set the trigger, press the [Measurement start] button .
4. The following window is the sample of the measurement data.



In upper sample, the waveform on rapid traverse to R point and on tapping from R point are displayed.

Blue : Velocity on Z axis
Red : Synchronous error

5. The synchronous error data from linear to R point is no meaning because the program doesn't take synchronous mode between servo and spindle.
Then to see more easily the part of tapping actually, red waveform is zoomed in vertical.
With [Arrow] button  is kept on, click the arbitrary point on red waveform, so the red waveform becomes bold line.
To press the [Zoom in at vertical] button  at some times, zoom the waveform till the suitable size.



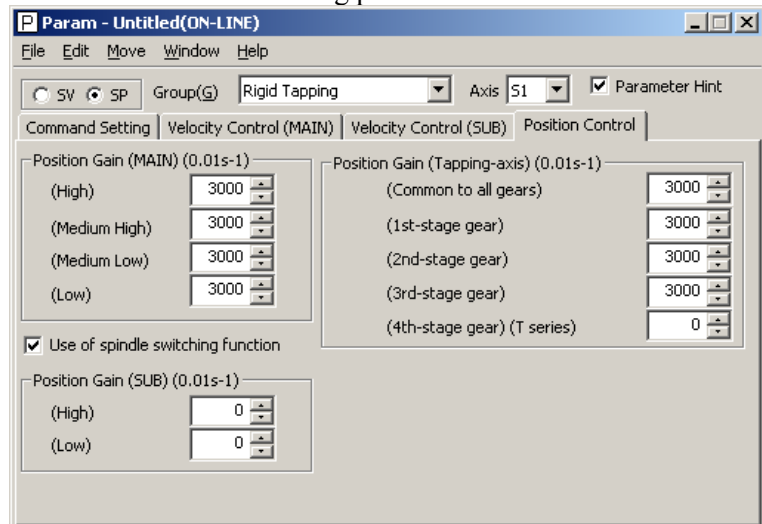
To click the white part on graph, the red waveform turn to the thin line.

1.6.5 Tuning of Parameters

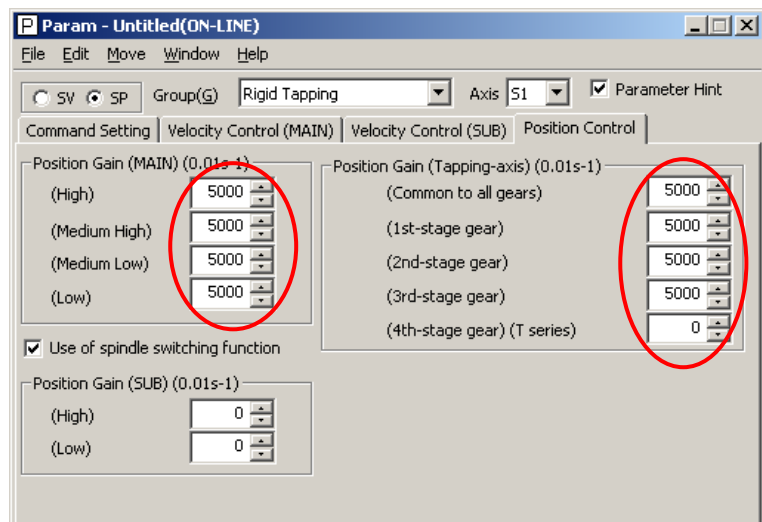
The parameters are tuned with considering the result of measurement. It is shown to tune the Position gain.




1. The first procedure is to open the Parameter Window in ONLINE state.
2. The second procedure is to check the [SP] side at [Servo spindle parameter switching] radio button in Parameter Window.
3. The third procedure is to select the [Rigid tapping] in the combo box on function select.
4. The fourth procedure is to select the [Position control] on function select tab.

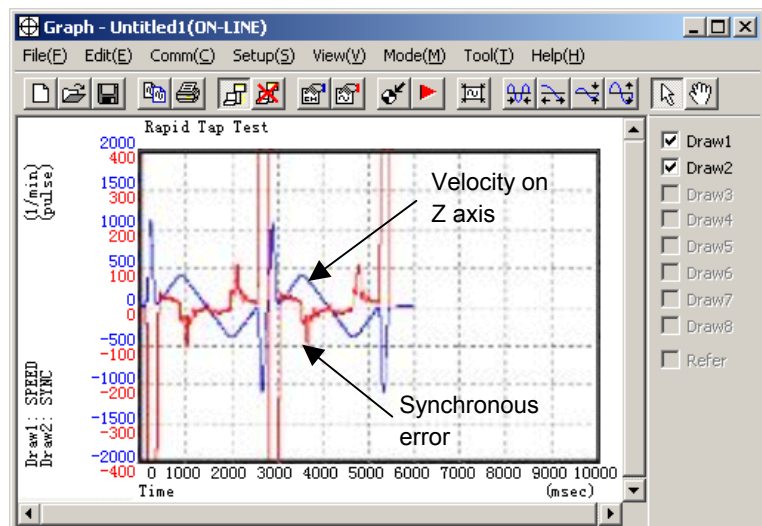
You can see as the following picture.



5. To raise the position gain, it is necessary to change as the following.



- * There is the case that you see the message of [NC power OFF] when you change the parameter.
In this case, it is necessary to turn NC off and on. Then operate as the following.
Parameter window:
It is necessary to press the [Reconnection] in [File] menu.
Program window:
It is necessary to press the [Reconnection] in [File] menu.
Graph window:
It is necessary to press the [Disconnection] button  at first and to press the [Connection] button .
6. The sixth procedure is to measure the data again.
If you press the [Channel setting] button  and change [Auto scale] to [disable] before measurement, you can compare to the previous data more easily.



You can see that the synchronous error is lower by the raising the position gain.

1.7 TUNING OF CONTOUR ERROR BY MEASURING A Cs CONTOUR CONTROL PATH

You can measure and tune in the following procedure.

- 1 The first procedure is to make the test program for the Cs contouring control in Program Window.
- 2 The second procedure is to set for measurement in Graph Window.
- 3 The third procedure is to run the program and to measure the data.
- 4 The fourth procedure is to tune the parameter as the need arises.

1.7.1 Test Program

In the Program Window, you can make and send the program in the following procedure.

1. The first procedure is to make the program by setting the various condition.

Program Mode: Cs program Lathe

Horiz.-axis: X Vert.-axis: C G code: A B or C

Axis Feed: Cutting feed Rapid-traverse

Side Length: 40 Radius: 5

Feedrate: 1000 Main axis Velocity: 1000

Tapping M code: M29 Repeat: 1

Start Positon: -30

High Precision Control Mode: Normal

use High Speed HRV Current Control

N (sequence number) for Trigger: 1

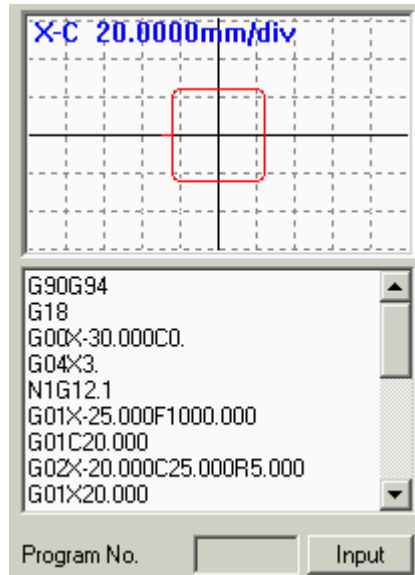
Buttons: Cancel, Apply

NOTE

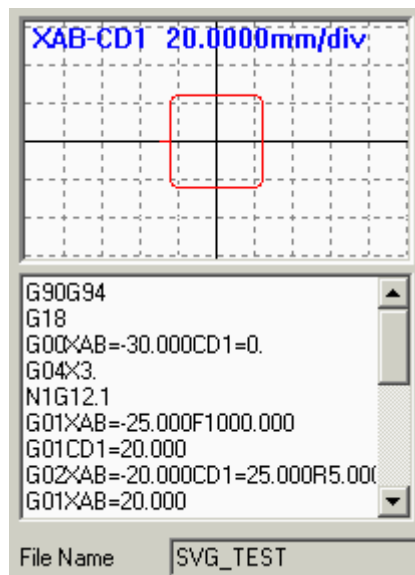
The test program of Cs contouring control uses the polar coordinate interpolation, so the absolute command is used.

It is necessary to be care to the setting value of [X coordinate value of start point].

2. Decide the program by pressing the <Apply> button .
 At the time of the FS16i connection, the number of the program is decided by pressing the <Input> button .
 At the time of the FS30i connection, the name of the program is decided by pressing the <File> button .





→ FS16i



→ FS30i

The program is made as the following. In case that the X value of start point is negative, the X-axis approaches from negative side. On the contrary, in case that the X value of start point is positive, the X-axis approaches from positive side.


- * It is necessary to confirm the program code that SERVO GUIDE make. If you want to modify the program and add the code for example M code, you can edit the program text directly.

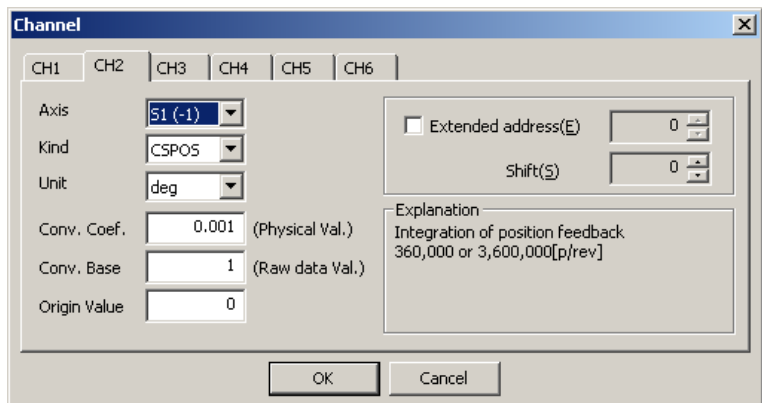
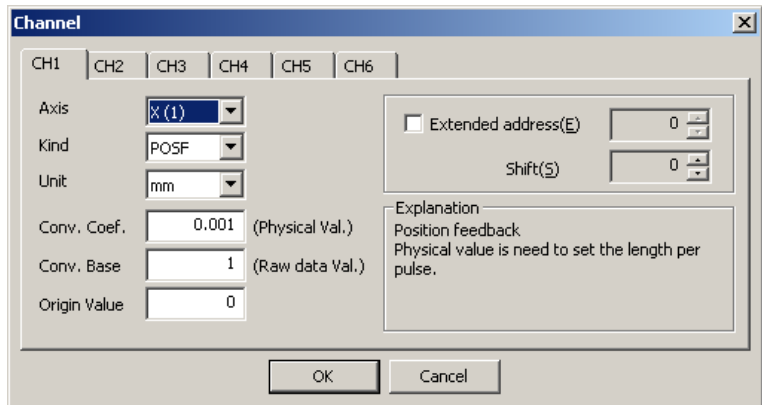
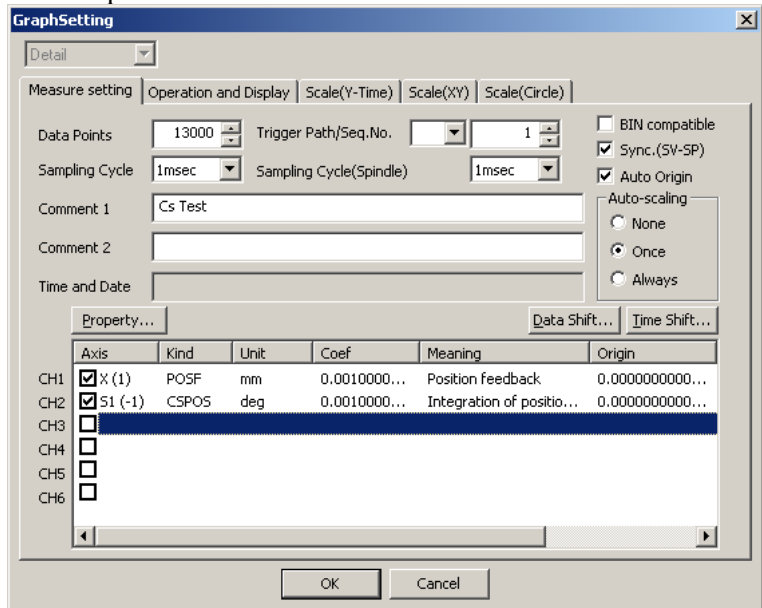
3. The third procedure is to press the [Sub-program transmission] button , the [Main-program transmission] button .
4. The fourth procedure is to press the Cycle start button of machine. It is necessary to confirm that the path of program is correct.


That's all for preparation in Program Window.

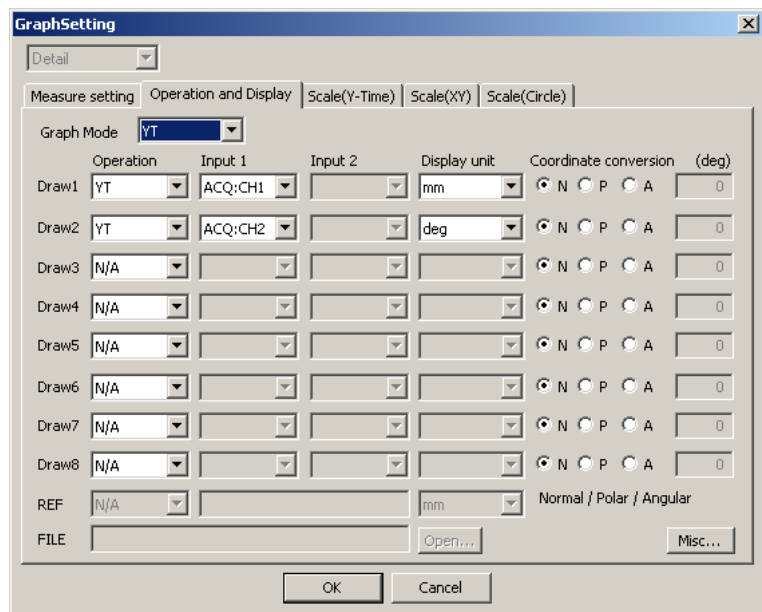
1.7.2 Preparation for Measurement

It is necessary to prepare the Graph Window setting in the following procedure.

1. The first procedure is to press the [Channel setting] button  and to set the graph display setting. The sample is shown for reference.



- * The upper window is set to display the integral value of positional feedback at X axis in CH1 and the integral value of positional feedback at S1 axis (Spindle axis) in CH2.
- 2. The second procedure is to turn back main of Graph Window, to change Y-T mode by pressing [Ctrl]+[T].
- 3. The third procedure is to set the display setting after pressing the [Calculation display] button . The sample is shown for reference.






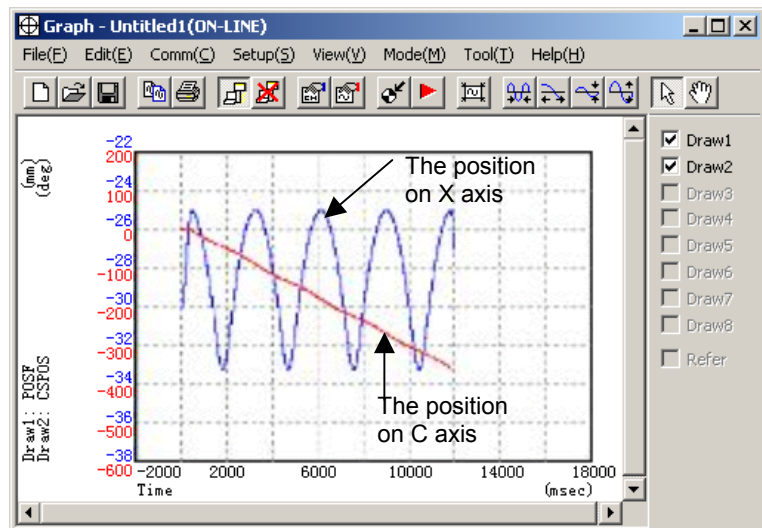
The upper window is set to display the raw data of CH1 in Draw1 and the raw one of CH2 in Draw2.

- 4. Returning main window, this setting is terminated.

1.7.3 Measurement

You can measure the data in the following procedure.

1. The program made in the Program Window, at first, commands to move to the following coordinate point (X,C) = (Setting start point), and stays as dwell for 3 seconds. Do the [Origin] at the timing. The first procedure is to explain how to start the program. It is necessary to press the [Main program transmission] button  in program window.
2. In the second procedure, you can begin running the program by the pressing the [Cycle start] button of machine.
3. For first dwell, the third procedure is to press the [Origin] button  at one time in graph window.
4. The fourth procedure is to press the [Measurement start] button , too.
(If you set the trigger, the state is trigger. If you don't set the trigger, the measurement starts immediately.)
5. The following window is the sample of the measurement data.

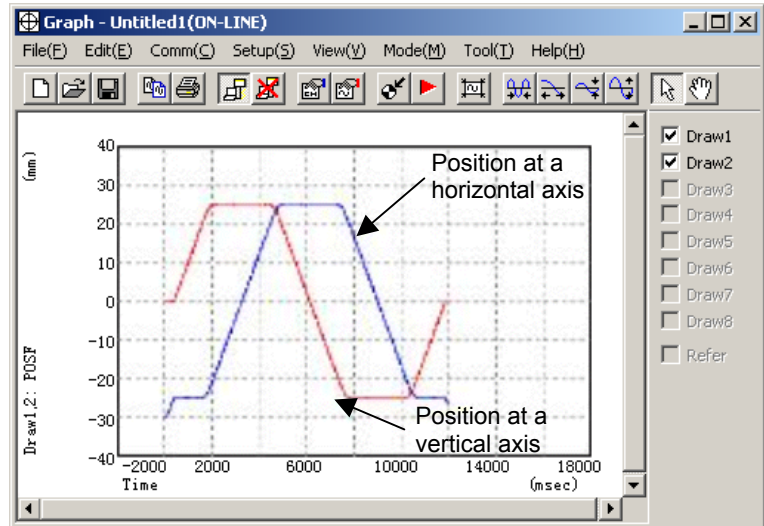


The upper window is displayed the position feedback integral value at each axis.

Blue: The position on X axis

Red: The position on C axis

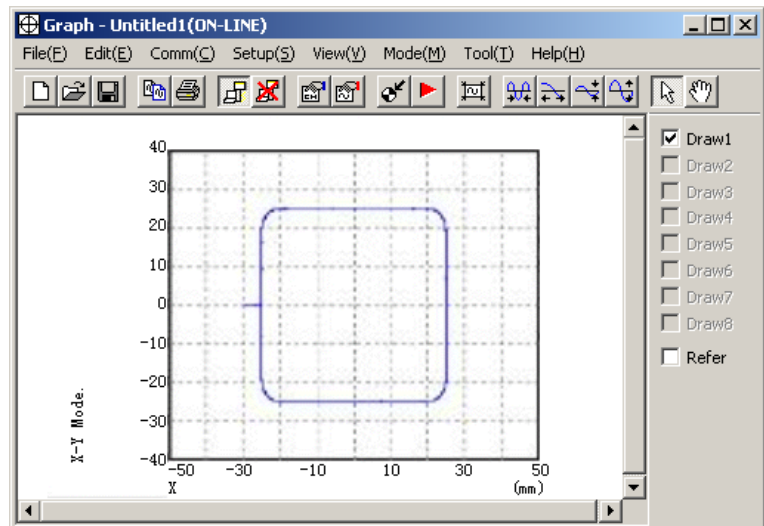
6. This data is transformed to polar coordinate. Press the [Ctrl]+[R], so you can get as the following waveform.




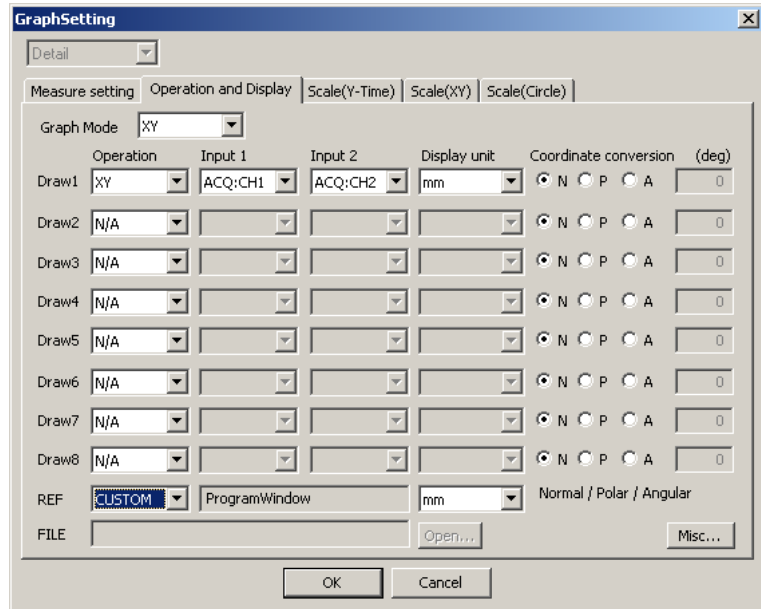
The above figure shows the contouring position in the horizontal axis and vertical axis as a result of the polar coordinate transformation using the X-axis position (radius) and C-axis position (angle).

Blue: Contouring position at a horizontal axis on cutting
 Red: Contouring position at a vertical axis on cutting

7. If you press the [Ctrl]+[X], the mode changes the XY mode. You can see as the following waveform.



8. If you want to compare upper waveform to the program path, it is necessary to do the following procedure.
The procedure is to press the [Calculation display] button  and select the program waveform as the reference.



If you select the [CUSTOM] in REF, you can get the command made in program window as the reference command.
The command program made in program window is approximated the segment whose length is 1 mm.
In case that the segment is too long, it is necessary to prepare the following text file.

Using of program path changed segment length

(The example of program path file)

```
-30.000, 0.000
-30.100, 0.000
...
```

The upper file is the text file that is divided with comma between the horizontal coordinate and the vertical coordinate.

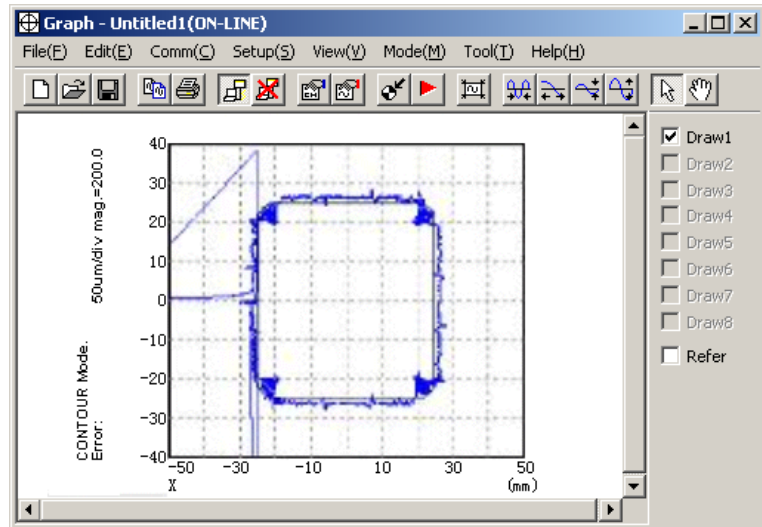
To read a program path file you created, select [FILE] in REF, and press the <Open> button to select the name of the program path file.

Reference

In case that you select the default parameter (approach +30, each side 40mm, radius of corner 5mm) at [Cs program making] in program window, reference waveform is prepared at [PRESET2] in REF combo box. You can the reference waveform.

9. After you decide the program path, turning the Graph Window, check the [Refer] in [Waveform ON/OFF panel].

10. Then, press [Ctrl]+[O] to enter the Contour mode (contouring comparison mode).
You see as the following contouring error.



If you press the "U(up)" or "D(down)", you can zoom up or down the contouring error. Change the zooming ratio as necessary.

On contouring comparison mode, if you have the point that is passed at plural times on one path, sometimes the waveform is disturbed.

That reason is that the point to compare can't be decided at one point. The program, made by the program window of SERVO GUIDE, isn't considered that things.

So it isn't deny that the phenomenon doesn't occur. In upper example, at the corner near the start point, the orbit is disturbed.

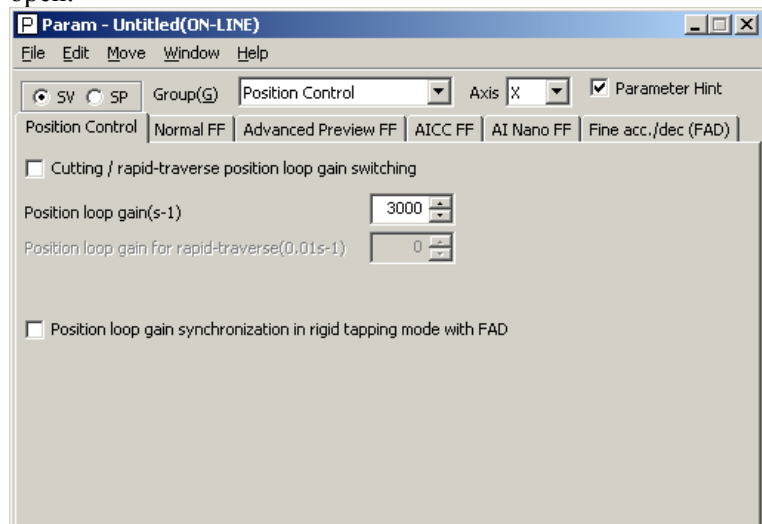
Reference

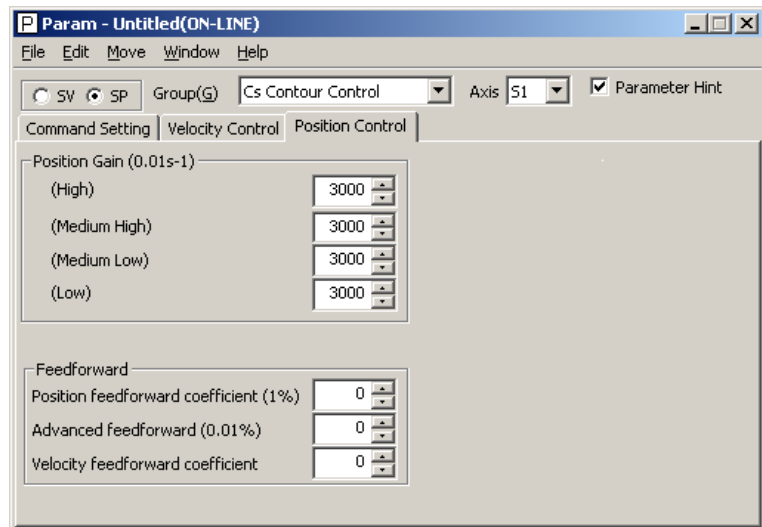
If the resultant square is tilted, press [Channel setting] and try to correct an offset value for measurement data or shift the time axis. (For details, see Subsection 5.12.1, "Measurement Data Value Scaling", and Subsection 5.12.2, "Measurement Data Time Shift", in part I.)

1.7.4 Tuning of Parameters

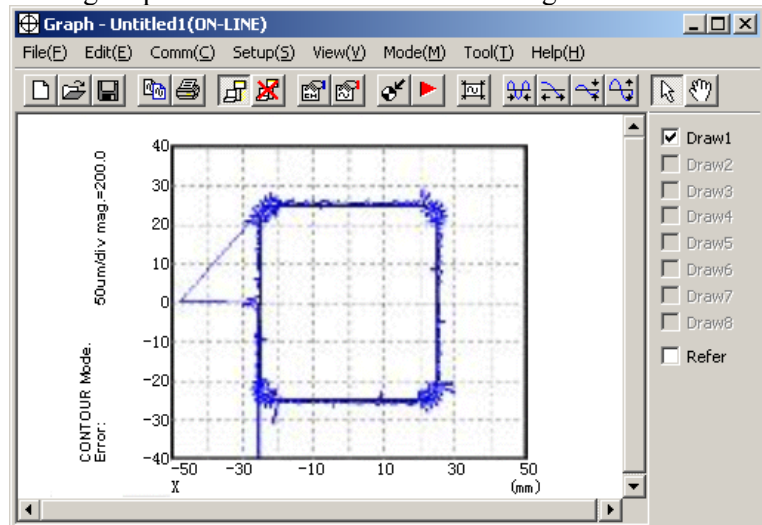
The parameters are tuned with considering the result of measurement. It is shown to tune Position gain.

1. The first procedure is to open the Parameter Window in ONLINE state.
2. The second procedure is to select the [Position control relation] in the combo box on function select.
(The [Positional gain] is displayed in the function select tab.)
3. The third procedure is to select the [Open the other window on the same parameter] in the window menu.
4. After opening the other window, the fourth procedure is to make the later window active and to check [SP] side in [Servo spindle parameter switching] radio button.
5. The fifth procedure is to select the [Cs contouring control relation] in combo box of function select.
6. Then, select the [Position Control] function selection tab. After the above steps have been done, the following window should be open:





7. To raise the positional gain, in upper two windows, tune the [Positional gain] setting.
8. The eighth procedure is to measure the data again.



You can see that the synchronous error become less by the raising the positional gain.

It seems that the contouring error at the corner part is large. This phenomenon is occurred by the following reason. That's why the command path data used reference, made in program window, consists of 1mm segments. If you want to observe that corner in detail, it is necessary to prepare the program path file whose segments are shorter than 1mm.

1.8 ANALYSIS OF VIBRATION FREQUENCY DURING FEED AT CONSTANT FEEDRATE

You can measure in the following procedure.

- 1 The first procedure is to make the test program of straight movement in Program Window.
- 2 The second procedure is to set for measurement in Graph Window.
- 3 The third procedure is to run the program and to measure the data.

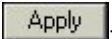
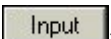

1.8.1 Test Program

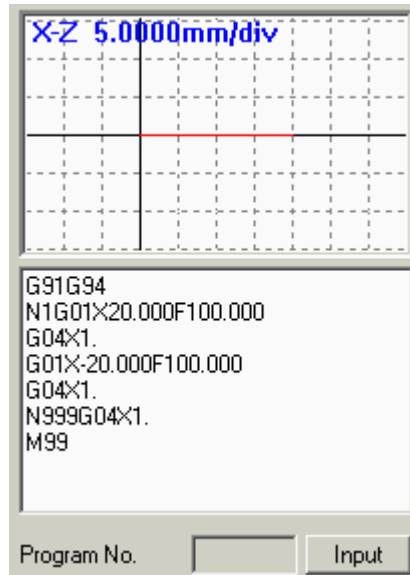
In the Program Window, you can make and send the program in the following procedure.

1. The first procedure is to make the program by setting the various conditions.

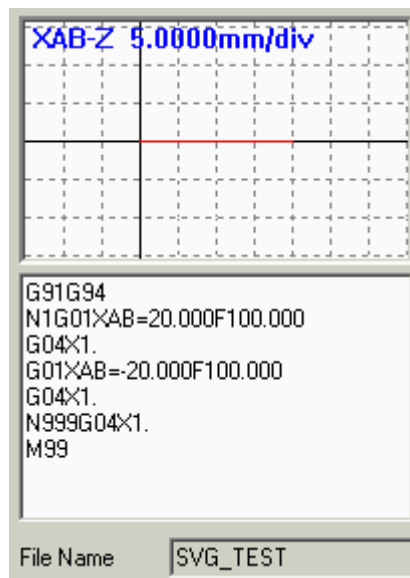
The screenshot shows a dialog box for setting program parameters. The 'Program Mode' is set to 'Straight movement'. The 'Lathe' checkbox is unchecked. The 'Horiz.-axis' is set to 'X' and the 'Vert.-axis' is set to 'Y'. The 'G code' is set to 'A'. The 'Axis Feed' is set to 'Cutting feed'. The 'Traverse Length' is 20, 'Radius' is 10, 'Feedrate' is 100, 'Main axis Velocity' is 2000, 'Tapping M code' is 'M29', 'Repeat' is 1, and 'Start Positon' is 30. The 'High Precision Control Mode' is set to 'Normal'. The 'use High Speed HRV Current Control' checkbox is unchecked. The 'N (sequence number) for Trigger' is 1. There are 'Cancel' and 'Apply' buttons.

Program Mode	Straight movement	<input type="checkbox"/> Lathe			
Horiz.-axis	X	Vert.-axis	Y	G code	<input type="radio"/> A
Axis Feed	<input checked="" type="radio"/> Cutting feed	<input type="radio"/> Rapid-traverse			<input type="radio"/> B or C
Traverse Length	20	Radius	10		
Feedrate	100	Main axis Velocity	2000		
Tapping M code	M29	Repeat	1		
		Start Positon	30		
High Precision Control Mode	Normal				
<input type="checkbox"/> use High Speed HRV Current Control		Cancel			
N (sequence number) for Trigger	1	Apply			



2. Decide the program by pressing the <Apply> button .
 At the time of the FS16i connection, the number of the program is decided by pressing the <Input> button .
 At the time of the FS30i connection, the name of the program is decided by pressing the <File> button .



→ FS16i



→ FS30i


- * It is necessary to confirm the program code that SERVO GUIDE makes.
 If you want to modify the program and add the code for example M code, you can edit the program text directly.
3. The third procedure is to press the [Sub-program transmission] button , the [Main-program transmission] button .

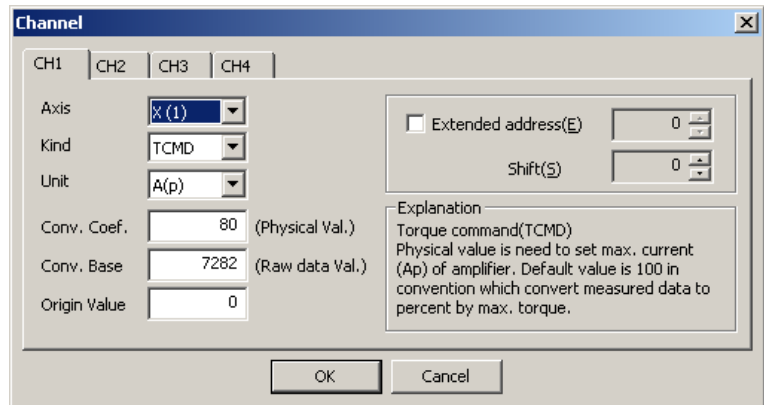
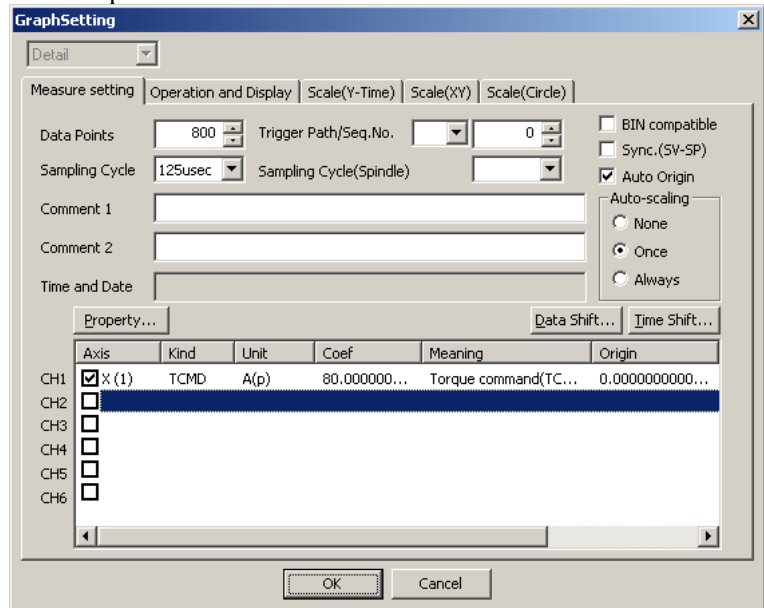
4. The fourth procedure is to press the Cycle start button of machine. It is necessary to confirm that the path of program is correct.

That's all for preparation in Program Window.

1.8.2 Preparation for Measurement

It is necessary to prepare the Graph Window setting in the following procedure.


1. The first procedure is to press the [Channel setting] button  and to set the graph display setting. The sample is shown for reference.

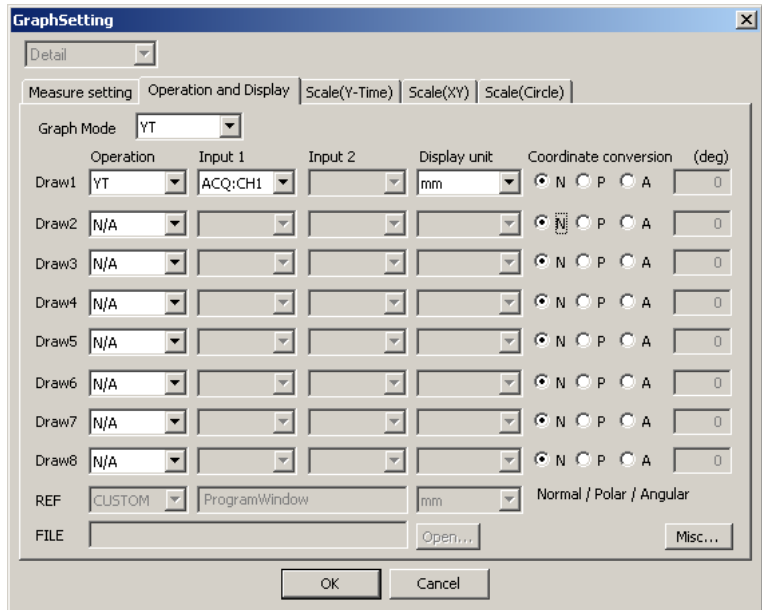


The upper example is set to display the torque command to CH1. The sampling period is set to 125 μ s. The number of data points are set to 800(0.1 second). To measure till the high frequency, the sampling time should be set shorter.

- * If you don't use the HRV2 control or more, you can't set sampling period to 125 μ s.

The trigger number isn't set.

2. The second procedure is to turn back main of Graph Window, to change Y-T mode by pressing [Ctrl]+[T].
3. The third procedure is to set the display setting after pressing the [Calculation display] button . The sample is shown for reference.






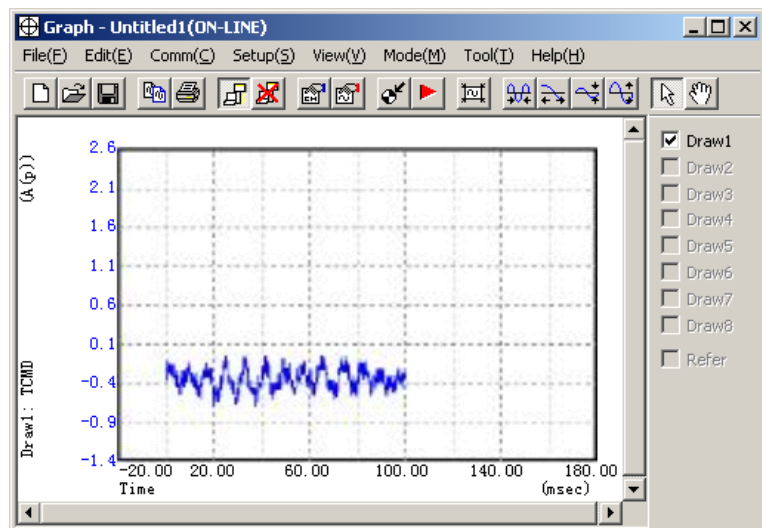
Draw1 is set so that data measured on CH1 is displayed directly.

4. Returning main window, this setting is terminated.

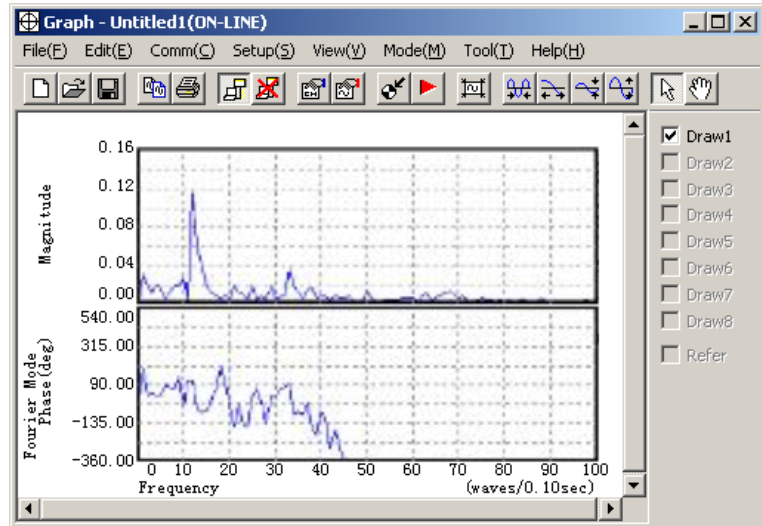
1.8.3 Measurement

You can measure the data in the following procedure.

1. The first procedure is to press [Origin] button  at one time in Graph Window.
2. The second procedure is to press the [Main program transmission] button  in Program Window.
3. The third procedure is to run the program by the pressing the [Cycle start] button of machine.
In case that axis begins moving, press the [Measurement start] button .
4. The following window is the sample of the measurement data.



- To transform this waveform to Fourier, it is necessary to press the [Ctrl]+[F].



The upper graph has the peak of amplitude at 12(waves/0.1sec). You can see that the frequency of the resonant point is 120 Hz in this case. If you see the frequency of the resonant point, you had better use the filter function of the frequency. Then you can raise the gain for example velocity loop gain with suppressing the resonance.

1.9 MEASUREMENT OF THE VELOCITY LOOP FREQUENCY RESPONSE OF A SERVO AXIS

You can measure in the following procedure.

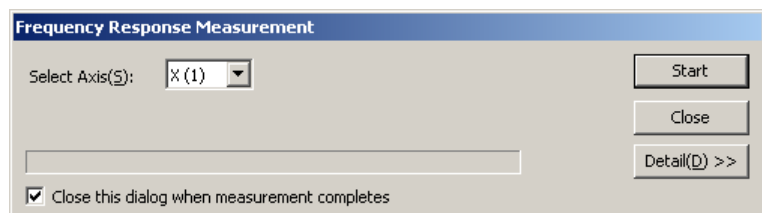
- 1 The first procedure is to set the parameter for measurement data in Graph Window.
- 2 The second procedure is to measure the data.

1.9.1 Preparation for Measurement

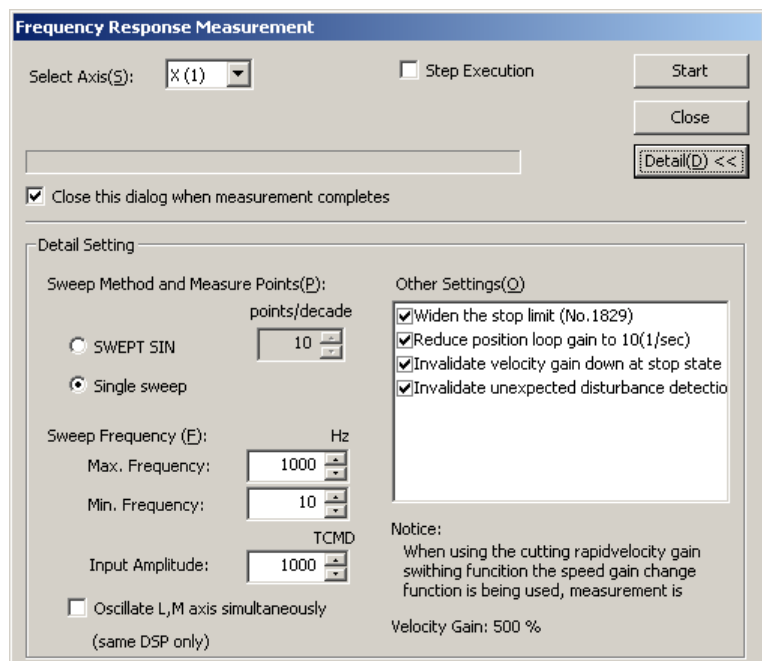
It is necessary to prepare the Graph Window setting in the following procedure.

1. Select the items from menu in the following order, [Tool] [Frequency analysis] [Measurement].

You see the following dialog, select the axis of measurement.



2. Usually the setting in this window is terminated, but if you set the parameter in detail, you can press the [Detail] button. Pressing the [Detail] button, the dialog becomes larger and the number of the parameters increases.

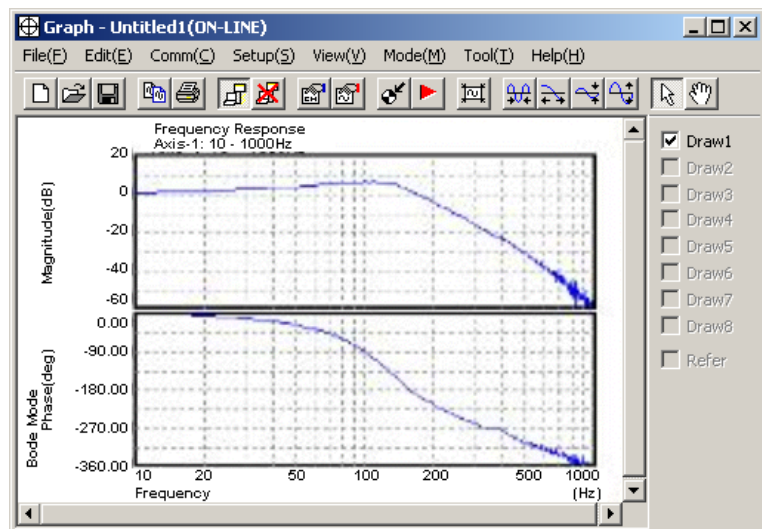


In this page, you can change the condition of measurement. About the contents, refer the [Frequency characteristic] page.

1.9.2 Measurement

You can measure the data in the following procedure.

1. The first procedure is to press the [Measurement start] in frequency characteristic measurement dialog.
2. After the machine moves with some seconds, you can see the Bode diagram as following.



You can see the frequency of the resonant point from this Bode diagram. If you use some filter functions, you can raise the gain, for example the velocity loop gain, with suppressing the resonance. To get the Bode diagrams of some machines by using the same parameter, you can see the individual differences of each machine also.

1.10 MEASUREMENT OF THE VELOCITY LOOP FREQUENCY RESPONSE OF A SPINDLE AXIS

You can measure in the following procedure.

- 1 The first procedure is to change the operation mode to the velocity control mode.
- 2 The second procedure is to set the parameter for disturbance input function
- 3 The third procedure is to set the parameter for measurement data in Graph Window.
- 4 The fourth procedure is to measure the data.
- 5 After completing measurement, turn off motor excitation and reset all parameters for the disturbance input function to 0.

NOTE

The operation procedure explained here has many operation steps and requires use of a special display method. FANUC plans to improve the software in the future.

1.10.1 Parameter Setting

Setting of Disturbance Input Function


Input following parameters for using disturbance input function.

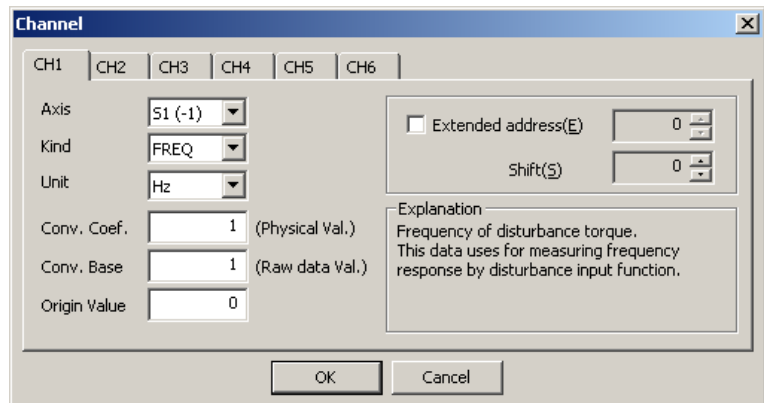
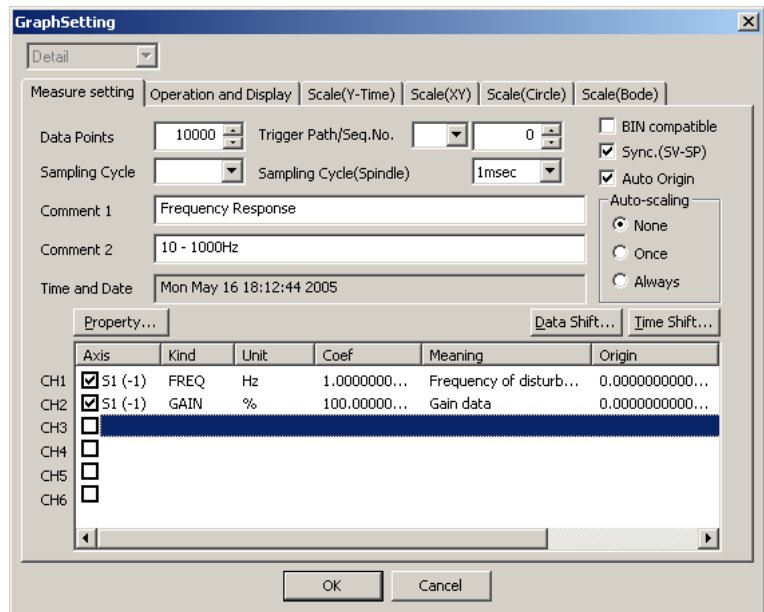
- Disturbance input function bit
No.4395#7(DTQFNC) = 1
This bit is enabled only when S0 is specified in the velocity control mode.
If this bit is set to 1 under conditions other than the above, the spindle amplifier results in a status error (error No. 32), and the excitation of the spindle motor is turned off.
- Disturbance input start trigger bit
No.4395#6(DTQTRG) = 0
When this bit is set to ON (0 -> 1) while excitation is ON (SFR = 1 or SRV = 1), the disturbance input starts.
When this bit is set to OFF during measurement, the disturbance input is stopped in the middle.
- Start frequency/End frequency of disturbance input
No.4410 = 10, No.4411 = 1000
Set the frequency range of disturbance input. (parameter unit: Hz)
- Disturbance torque command amplitude
No.4414 = 5
- Set the amplitude of the disturbance torque command. (parameter unit: %)
This parameter means percent ratio for maximum torque command.

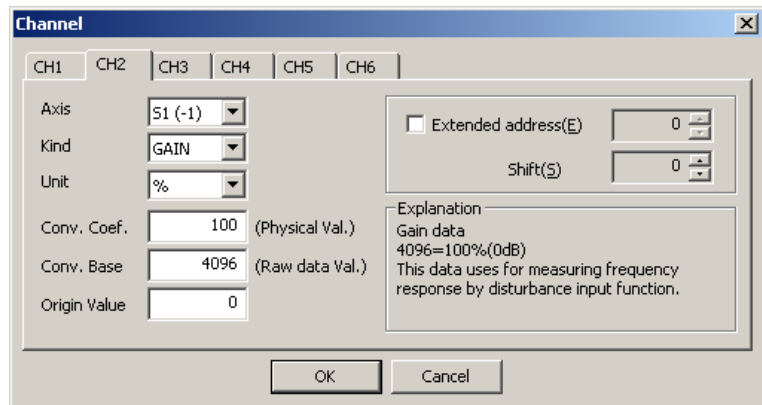
- Other parameters
No. 4412, 4413, 4415, 4030
- For these parameters, default setting value (zero) may be used, and set appropriate value as necessary. For detail, refer to the parameter manual of spindle motor (B-65280EN)

1.10.2 Preparation for Measurement

It is necessary to prepare the Graph Window setting in the following procedure.

1. The first procedure is to press the [Channel setting] button  and to set the graph display setting. The sample is shown for reference.







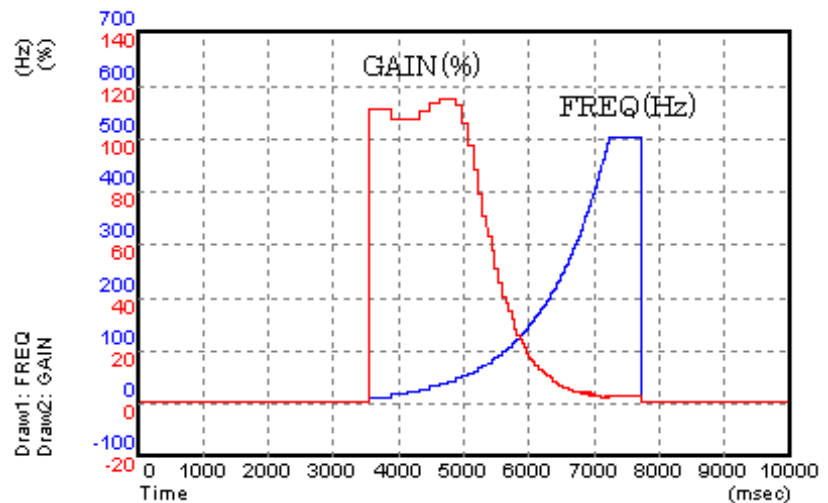
- * The upper window is set to display the disturbance frequency in CH1 and the gain in CH2.

1.10.3 Measurement

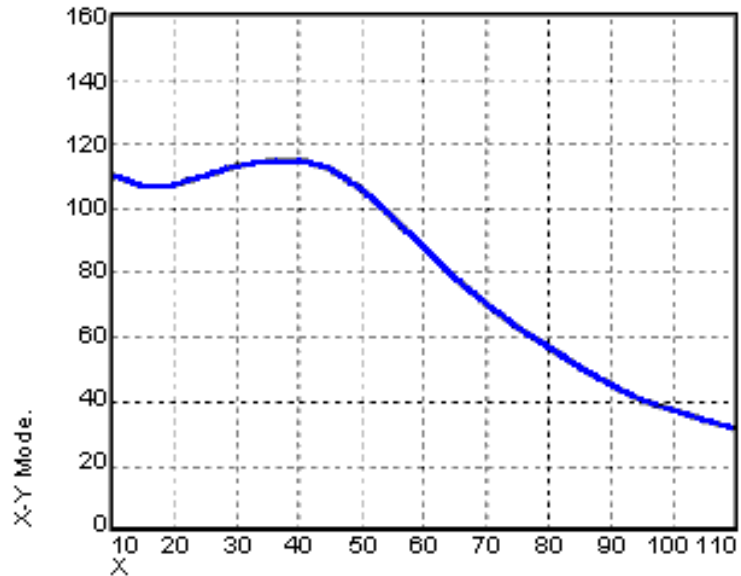
You can measure the data in the following procedure.

1. Issue the S0 command and turn on excitation (SFR = 1 or SRV = 1).
2. The second procedure is to press [Origin] button  at one time in Graph Window.
3. Press the [Measurement start] button , and set disturbance input start trigger bit DTQTRG (No.4395#6) from 0 to 1.
4. After the motor vibrates some seconds, you can see the following waveform.
If one of the following conditions is satisfied during measurement, disturbance input is interrupted and the motor decelerates then stops:
 - <1> The measurement start trigger is turned off. (DTQTRG = 0)
 - <2> Spindle motor excitation is turned off. (SFR = 0, SRV = 0)
 - <3> An emergency stop is applied.

(Y-Time mode display)



5. If you press the [Ctrl]+[X], the mode changes the XY mode. You can see the following waveform as frequency response. The horizontal axis means frequency and the vertical axis means gain. You can see the frequency of the resonant point or bandwidth of velocity control loop.



6. To restart measurements, set disturbance input start trigger DTQTRG to ON (0 → 1).
In HRV filter adjustment, a measurement and parameter change must be repeated.
So adjust the filter by repeating the following steps:
Starting measurement (DTQTRG = 1) → End of measurement → DTQTRG = 0 → Changing the HRV filter parameters → Starting measurement (DTQTRG = 1) and so on.
7. After completing measurements (adjustment), turn off motor excitation and reset all the parameters for the disturbance input function to 0.

1.11 LINEAR MOTOR SMOOTHING COMPENSATION

You can measure and tune in the following procedure.

- 1 The first procedure is to make the test program of linear reciprocating motion in Program Window.
- 2 The second procedure is to set for measurement in Graph Window.
- 3 The third procedure is to run the program, to measure the data and to determine the parameters for the compensation.

NOTE

When a synchronous built-in servo motor (DD motor) is used, smoothing compensation can be used in the same way as for linear motors by setting bit 7 of parameter No. 2203 to 1. (Version 3.00 and later)

1.11.1 Test Program

In the Program Window, you can make and send the program in the following procedure.

1. The first procedure is to make the program by setting the various condition.

The screenshot shows a dialog box for setting program parameters. The settings are as follows:

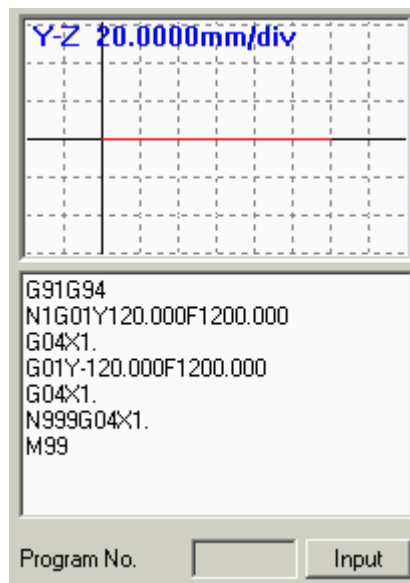
- Program Mode: Straight movement
- M type: (dropdown menu)
- Horiz.-axis: Y
- Vert.-axis: Z
- G code: A (selected), B or C (unselected)
- Axis Feed: Cutting feed (selected), Rapid-traverse (unselected)
- Traverse Length: 120
- Radius: 10
- Feedrate: 1200
- Main axis Velocity: 1000
- Tapping M code: M29
- Repeat: 1
- Start Position: 30
- High Precision Control Mode: Normal
- use High Speed HRV Current Control: (checkbox unchecked)
- N (sequence number) for Trigger: 1

Make the program, which make the target axis move the distance of two magnetic poles. The speed is about 6sec per one direction move. The above example is the distance of one magnetic pole = 60mm the speed is 1200mm/min. (When the speed is too fast, the parameter calculation may become wrong.)

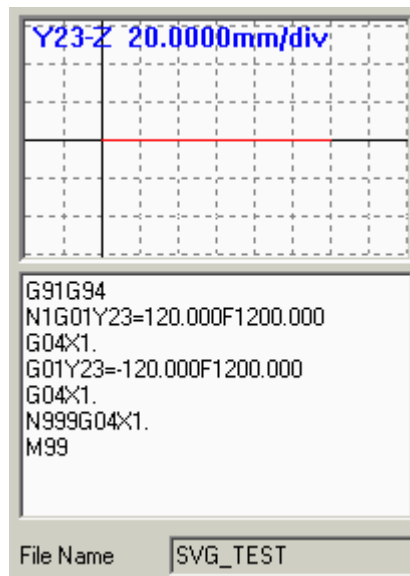
NOTE

If you use Synchronous Built-in Servo Motor with N poles, the speed for measurement is 14400/N deg/min.



2. Decide the program by pressing the <Apply> button .
 At the time of the FS16i connection, the number of the program is decided by pressing the <Input> button .
 At the time of the FS30i connection, the name of the program is decided by pressing the <File> button .



→ FS16i




→ FS30i

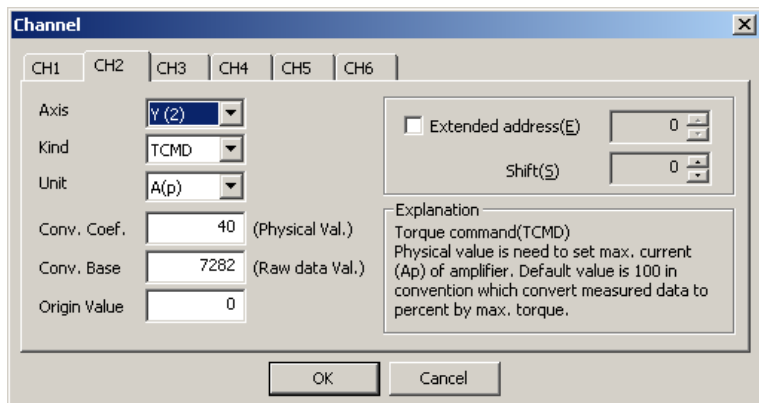
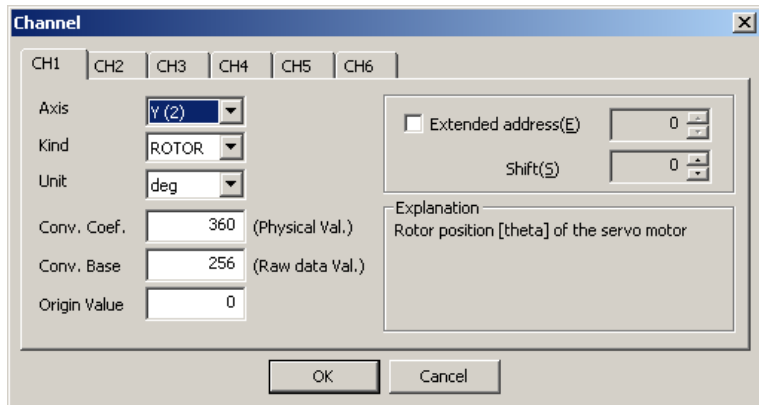
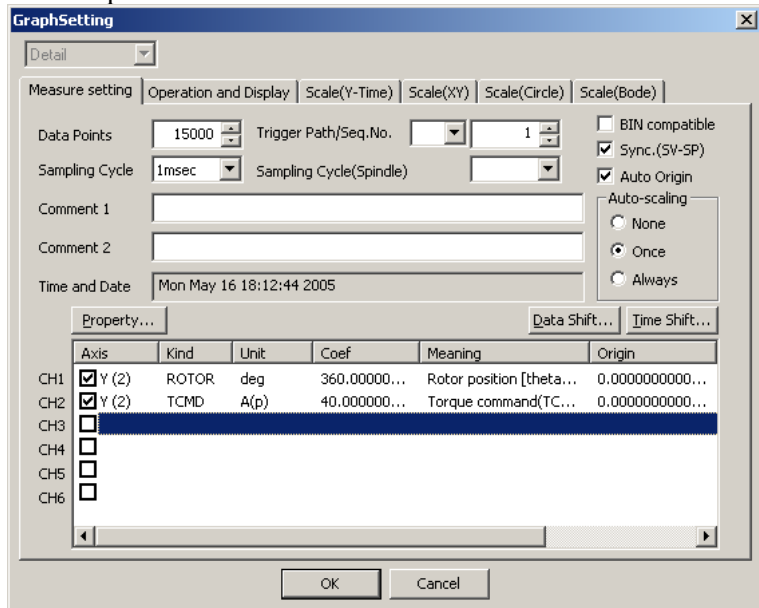
- * It is necessary to confirm the program code that SERVO GUIDE makes. If you want to modify the program and add the code for example M code, you can edit the program text directly.
- 3. The third procedure is to press the [Sub-program transmission] button , the [Main-program transmission] button .
- 4. The fourth procedure is to press the Cycle start button of machine. It is necessary to confirm that the path of program is correct.

That's all for preparation in Program Window.

1.11.2 Preparation for Measurement

It is necessary to prepare the Graph Window setting in the following procedure.


1. The first procedure is to press the [Channel setting] button  and to set the graph display setting. The sample is shown for reference.

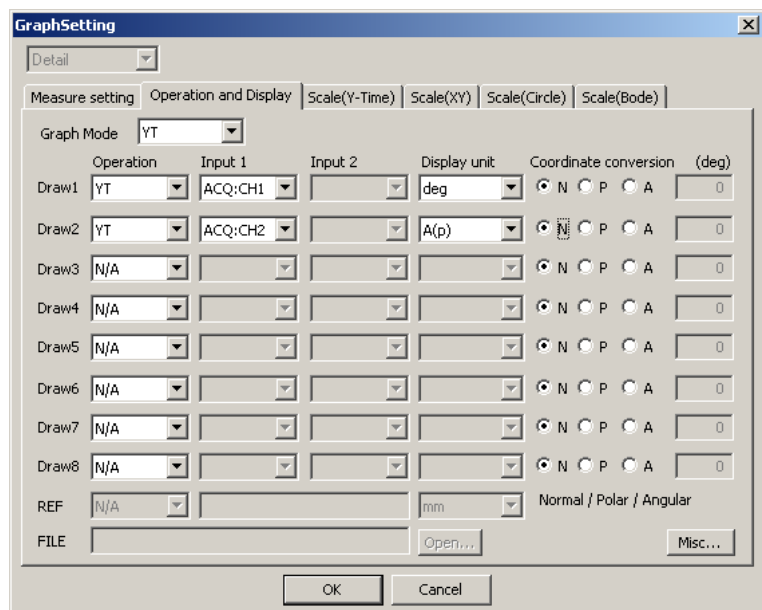


In upper windows, it is set that rotor position (ROTOR) is displayed on CH1, torque command (TCMD) is displayed on CH2. (Don't make a mistake in reverse order.)

- * In upper example, the setting of CH2 is tuned for 40A amplifier. Set the conversion coefficient for max current value of amplifier you use.

Set enough measurement time to measure all the data during one go-back. In above example, we use 15000 points (15 seconds) with 1ms sampling.

2. The second procedure is to turn back main of Graph Window, to change Y-T mode by pressing [Ctrl]+[T].
3. The third procedure is to set the display setting after pressing the [Calculation display] button . The sample is shown for reference.







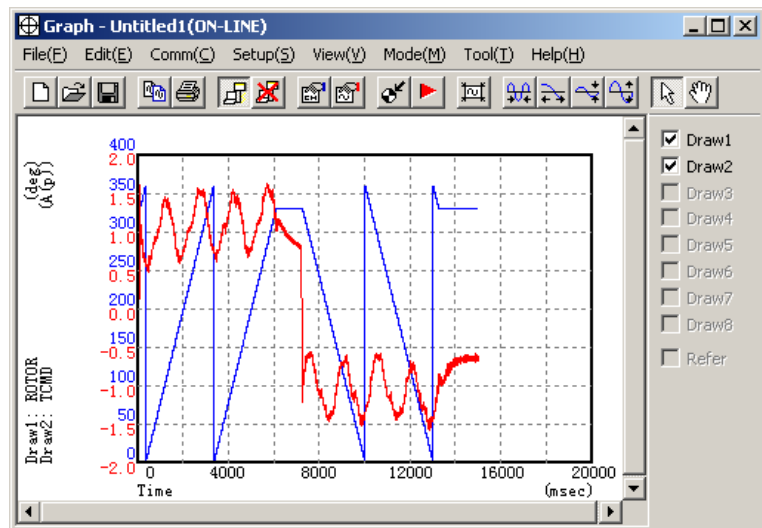
The upper window is displayed the raw results of measurement data. The data on CH1 and CH2 is displayed at Draw1 and Draw2.

4. Returning main window, this setting is terminated.

1.11.3 Measurement and Parameter setting

You can measure the data in the following procedure.

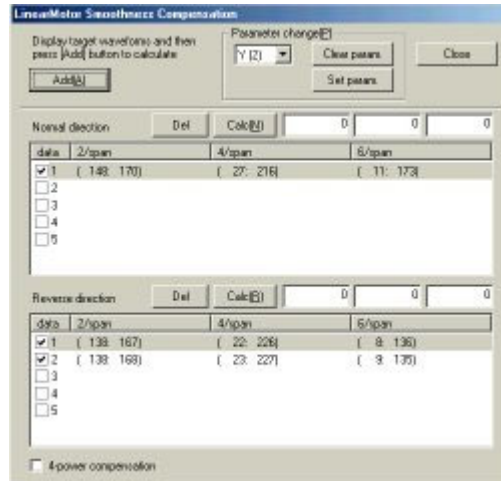
1. The first procedure is to press [Origin] button  at one time in Graph Window.
In case that you set trigger, press the [Measurement start] button , too. (The mode changes to trigger waiting mode.)
2. The second procedure is to press the [Main program transmission] button  in Program Window.
3. The third procedure is to run the program by the pressing the Cycle start button of machine.
In case that you set the trigger, the data measurement starts at the same time in Graph Window.
In case that you don't set the trigger, press the [Measurement start] button .
4. The following window is the sample of the measurement data.



Blue: Rotor position
Red: Torque command

- Press [Ctrl]+[L]. (or select [LinearMotorComp.Cal.] in [Tool] menu.)

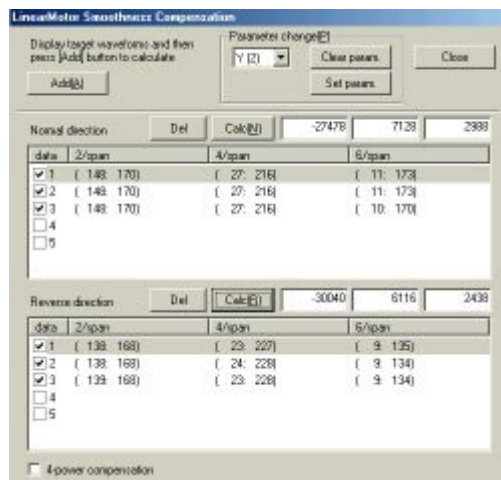
Press [Add] button in the new dialog. A parameter is registered as candidate.



The estimated parameters have some unevenness according to the measurement condition. So try same [Add] procedure by using Program window and Graph window together. (The maximum number of try is 5.)

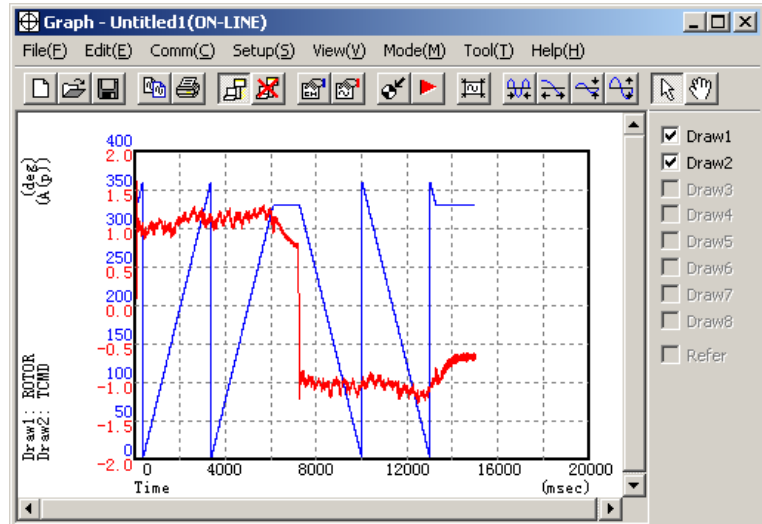
Check the analysed value. And if you find strange values, which are too much different from others, turn off the check-box, which is located in the left-side of the list. The value is not adopted in the final determination.

In the last, press [Calc] button both in normal direction part and in reverse direction part. The parameters to set must be shown.



- You can send the parameters to CNC by press [Set Param.] button.

7. Confirm the effect of the compensation by using Program window and Graph window.



APPENDIX

A

TROUBLESHOOTING

A.1 GENERAL TROUBLE SHOOTING

Q1) In the case that you don't know how to terminate SERVO GUIDE.

A1) Right-click on main bar and you can see the pop up menu. Select [Termination] in the menu .

Q2) In the case that you can't communicate with NC (via Ethernet).

A2) There are the following reasons in that case.

- * Setting of IP address or sub-net mask isn't matched between NC side and PC side.
- * Setting of IP address is different between NC side and SERVO GUIDE side.
- * There is a problem in LAN cable. (You may mistake the cable series (straight or cross), The cable may be broken.)

Q3) In the case that you can connect between Series 160is, 180is and 210is.

A3) You can't connect with PCMCIA-LAN card on *is* series for WindowsCE's occupation of card slot .
Therefore please connect with embedded Ethernet port.

Q4) SERVO GUIDE is something strange after NC power is OFF and ON.

A4) It is the reason to stop Ethernet communication when NC power is OFF.

To prevent it , when NC power is OFF , you had better terminate SERVO GUIDE at the same time.

If you don't want to terminate SERVO GUIDE, you try the following methods.



Parameter window :

Click the [Reconnection] in [File] menu.

Program window :

Click the [Reconnection] in [File] menu.

Graph window :

At first, click [disconnection] button  and click [Connection] button .

A.2 PARAMETER WINDOW

Q1) The screen is unstable.

A1) In Windows 98 and Me, when many Parameter Windows are open at the same time, the user resource may become insufficient. When many Parameter Windows are often open, Windows 2000 or XP should be used.

Q2) The layout of window is unstable.

A2) Using [Big font] as [System font] , the layout of window is unstable . Select [Setting] tab on [Monitor] property of control panel , change the font size from [Big font] to [Small font] in [Detail] . After change , use SERVO GUIDE.




Q3) On multi-path control systems, parameters of 2nd path and succeeding path can't be handled.

A3) SERVO GUIDE version 3.0 and later versions support multi-path systems. Parameters, however, are handled on a file-by-file basis. With the FS16*i*, therefore, multiple paths may be handled only when the Parameter Window is connected online. When a file is opened, parameters of only one path are displayed. With the FS30*i*, one file contains parameters of all paths, so even when a file is opened, multiple paths may be handled.

Q4) Parameters of loader control board can't be handled.

A4) The FS16*i* does not allow access to parameters of the loader control board via Ethernet. Therefore, in the Parameter Window, parameters of loader control board cannot be set. With the FS30*i*, the loader system is also controlled by the main CPU of the CNC, so the restriction mentioned above is not imposed.

A.3 GRAPH WINDOW

- Q1) The number of waveform you see is lower than one you select.
A1) It is possible that the number of check is less in the Draw Select Panel.
- Q2) The data isn't renewed after setting of measurement channel.
A2) Measurement channel information is transferred to the NC only when the channel setting button  in the menu or tool bar, or F9 is pressed to directly display the [Load data] tab, then OK is pressed on the screen. Note that information set after the [Load data] tab is selected from a dialog box that is displayed by pressing the [Calculation and display setting] button  is not transferred to the NC.
- Q3) You can't get the data correctly on polar coordinate interpolation.
A3) In the case of getting the data on polar coordinate interpolation, the coordinate value of X-axis at start point is important. Set coordinate value of start point correctly as origin point .
- Q4) Though you want to get the data of spindle axis, you don't see the "S1" at combo box in axis setting .
A4) Unless the sampling period for spindle axes has been set, no spindle axis can be selected. Check whether the sampling period for spindle axes is set.
- Q5) The scale of waveform is wrong by some multiplication.
A5) The display unit of waveform may be wrong. (example: TCMD is measured but display unit is not [um] but [Ap].)
Press the [Calculation and display setting] button  or F5 then press OK. Alternatively, press [Ctrl]+[T], and correct the display unit.
- Q6) At Series 30i/31i/32i, axis can not be selected.
A6) If parameters related to system configuration are wrong, axis can not be selected properly. Check parameters No.981 and No.982.
- Q7) Trigger does not work and sampling starts immediately.
A7) Although trigger condition is settled, sampling may start with no waiting for trigger according to circumstances.
It seems that the internal sequence number in the CNC is equal to trigger condition by some reason. Try to take the following actions (a) to (c):

Workaround

- a) If possible, change trigger condition and modify the test program.
- b) Modify the test program to shorten the program block that sequence number is equal to trigger condition. (Action to be taken when a reset occurs in the middle of execution)

- Trigger condition : N1

[Before] G91G94 N1G00X100.000 M99

[After] G91G94 N1 N2G00X100.000 M99
--

- c) Add dummy program for changing the sequence number after the actual test program is added and execute dummy program. (Internal sequence number in the CNC may change according to the next program of the actual test program.)

- Trigger condition : N1, Test program : O99

[Before] O1 O2 O99

If O1 is selected as a result of a search for the next to O99, a trigger may not occur properly.

[After] O1 O2 O99 O100

By adding the dummy program, O1 is now not next search of O99.

A.4 PROGRAM WINDOW

- Q1) In the case that you want to make the other program except for preserved program.
- A1) Select [Free Program] on program mode, edit the program edit box.
Select the horizontal axis and the vertical axis of target. Target objective, before clicking [Apply] button
- Q2) In the case that program path isn't displayed, or is displayed on the line.
- A2) The path is displayed on 2 axes that is selected at axis setting mode. So, if you mistake to select the axes, you can't show the path.
- Q3) In the case that the program path displayed is different from one made by program.
- A3) Only the G codes such as following codes are supported on simple path display of Program Window.
G01, G02, G03, G84, G12, 1
The paths commanded by other G codes are not displayed correctly perhaps.
Approve this point.
- Q4) On multi-path control systems, you can't make the program of second system or later.
- A4) SERVO GUIDE version 3.0 and later versions support multi-path systems. In the Program Window, it has become possible to select a path and create a program.
The FS16i does not allow access to programs of the loader control board via Ethernet. So, loader system programs cannot be created in the Program Window.
With the FS30i, the loader system is also controlled by the main CPU of the CNC, so the restriction mentioned above is not imposed.
- Q5) In the case of HPCC, AIHPCC and AINanoHPCC, you can't execute the program.
- A5) HPCC, AIHPCC and AINanoHPCC can't be executed by sub-program call in the past. But we revised it in the following CNC software series and editions. You can use them as same as other High speed & High precision modes.
- | | |
|----------------|--------------------|
| Series 16i-MB | : B0H1/20 or later |
| Series 16i-TB | : B1H1/20 or later |
| Series 18i-MB | : BDH1/20 or later |
| Series 18i-MB5 | : BDH5/10 or later |
| Series 18i-TB | : BEH1/20 or later |

A.5 TUNING NAVIGATOR

- Q1) In a multi-path NC, programs for the second and subsequent paths cannot be created.
- A1) SERVO GUIDE version 3.0 and later versions support multi-path systems. The FS16*i*, however, does not allow access to programs of the load control board via Ethernet, so the loader system is excluded from the supported paths.
- Q2) Programs for high precision contour control, AI high precision contour control, and AI nano high precision contour control cannot be executed.
- A2) Conventionally, it was impossible to execute programs for high precision contour control, AI high precision contour control, and AI nano high precision contour control. With the following NC software series and editions and later, it has become possible to execute such programs in the same manner as in other high precision modes:
- Series 16*i*-MB B0H1/20 and later
 - Series 16*i*-TB B1H1/20 and later
 - Series 18*i*-MB BDH1/20 and later
 - Series 18*i*-MB5 BDH5/10 and later
 - Series 18*i*-TB BEH1/20 and later
- Q3) Trigger does not occur properly and sampling starts immediately.
- A3) Although a trigger condition is set, sampling may start without waiting for a trigger. This may be because an internal sequence number in the CNC and the trigger condition match for a reason. Try to take the following actions (a) and (b):
- a) Correct the program to make the program block in which the sequence number and the trigger condition match as short as possible. (Action to be taken when a reset occurs in the middle of execution)

Before

```
G91G94  
N1G00X100.000  
M99
```

After

```
G91G94  
N1  
N2G00X100.000  
M99
```

- b) Add a dummy program as a new program to change the sequence number after a test program is executed first.
(After the test program is executed in MDI operation, an internal sequence number of the CNC may change to the sequence number of a program selected by the next program search.)

- When the test program is O99

Programs before addition of dummy program (in order of search)

O1
O2
O99

If O1 is selected as a result of a search for the next to O99, a trigger may not occur properly.

Programs after addition of dummy program (in order of search)

O1
O2
O99
O100

By adding a new program, O1 is no longer searched for next to O99.

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