WARNING

THE INSTALLATION SHALL BE MADE BY QUALIFIED INSTALLATION PERSONNEL AND SHOULD CONFORM TO ALL NATIONAL AND LOCAL CODES

Hyundai Robot

Hi4aVC071001FMEN3

Hi4a Controller Function Manual

Vibration Controller

HYUNDAI
HEAVY INDUSTRIES CO.,LTD.

HYUNDAI
HEAVY INDUSTRIES CO.,LTD.

Printed in Korea - Oct. 2007. 3rd Edition

Contents

1

System Version and Application Robot

Vibration controller of Hi4a is the control technology to solve the problem of residual vibration in existing PPI controller. Following system version is needed to use the vibration controller.

- **Main : After V10.03-05**
- **DSP : After V4.09**
- **Application Robot : HX165-02**

Application robot is in the plan of expansion based on 6 axis multi-joint robot.

2

Registration of Tool Information and Additional Information

Vibration controller of Hi4a controls by pose and load of robot inside of controller based on data of robot model every moment, so vibration is efficiently controllable by knowing accurate load of robot.

In the case of user doesn't input accurate load information or use wrong tool number, the big vibration will occur as a counter effect.

It has complicate sides compare to existing PPI controller but it is necessary condition to improve performance of robot using present control theory.

It requires inputting accurate information as it increases the control performance of robot controller.

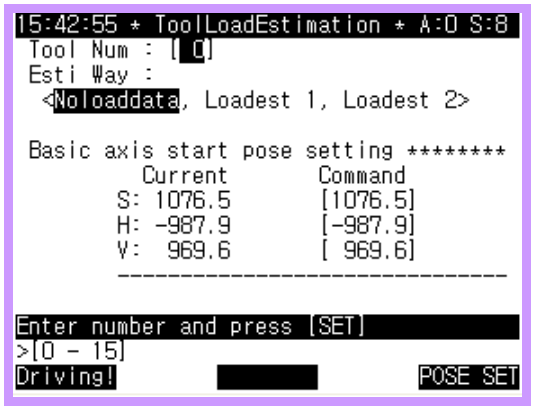
2.1. Registration of Tool Information

『[PF2]: System』→『3: Machine parameter』→『1: Tool data』 Directly input weight of tool and center of gravity from menu『[PF2]: System』→『6: Automatic constant setting』 → 『6: Load estimation』 input as presuming automatically from the function.

Basic value of tool weight is the test rated load according to the robot type when testing shipment of robot factory. In tool data, it is prepared to input inertia of tool other than weight and center of weight, it is not necessary to input if you don't know it specially.

The Load estimation function is the function that automatically calculates the weight and the center of gravity about various forms of tool load.
When it executes a load estimation function on the spot, there is a tendency where the load weight comes out a lot due to tension of various utility cables. The possibility of getting the accurate result is high when attaching tool and using load estimation 1 after executing no-load drawing up but the result from the method of normal load estimation 2 has the error of the degree which will not be the problem to use the vibration control.

The Load estimation function can be used when the robot is affixed on the horizontal plane as form of Floor. It will not be able to apply the form as affixing on the perpendicular plane or ceiling.
In order to use load estimation function due to the interference of workshop, the tool load must input manually in difficult condition.



The special caution while inputting tool information is to notify the accurate tool weight to controller using different tool number by steps at the condition which changes tool weight. If not, the vibration can be occurred.
In the case of below examples, the vibration will not occur when setting the weight of tool separately.

Example 1) In the case of using tool changer
T0 : When there is only a tool changer (in the case of changing tool)
T1 : When using tool 1
T2 : When using tool 2

Example 2) In the case of handling work
T0 : When there is only a hanger (in the case of setting the work down)
T1 : When the hanger is holding the work 1
T2 : When the hanger is holding the work 2

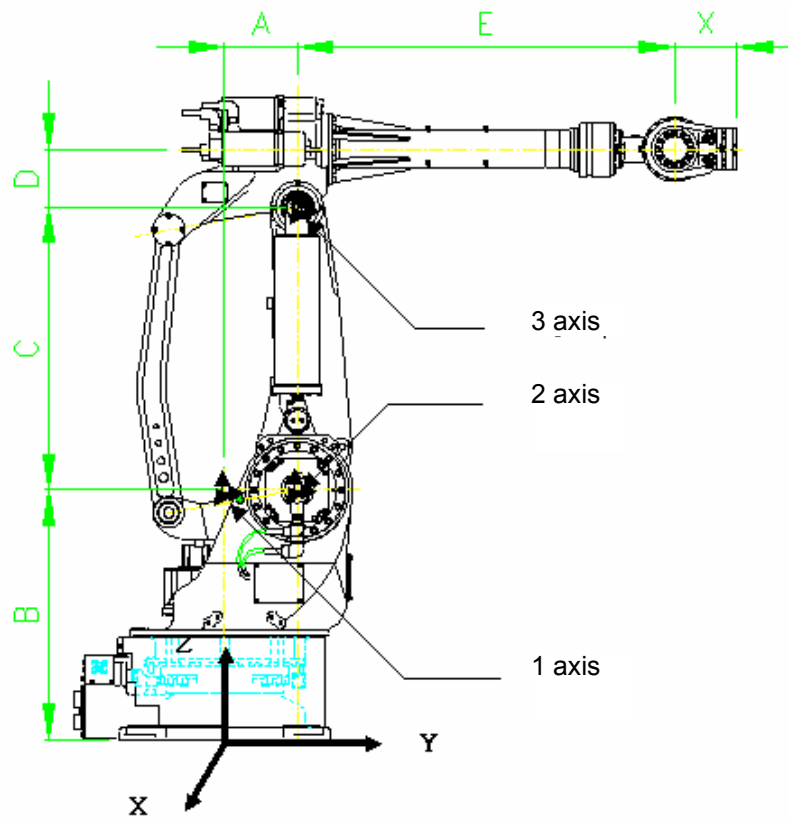
Little vibration can be occurred towards up and down directions when holding up and setting down of

M signal output on stop mode specially in the case of handling operation. This is due to different load weight but there is no method to let controller know about it.

2.2. Input of additional weight of axis

Load weight is 『[PF2]: System』 → 『3: Machine parameter』 → 『11: Additional weight on each axis』 input the user's load weight and the center of gravity at 1 axis, 2 axis, 3 axis from the menu. Additional weight is the device that is installed separately on S axis, H axis, V axis. Additional weight like tool load also is the important component to settle the same characteristic of robot, so the characteristic of vibration controller will improve as inputting accurate value. Load presumed function is not prepared separately about the additional weight.

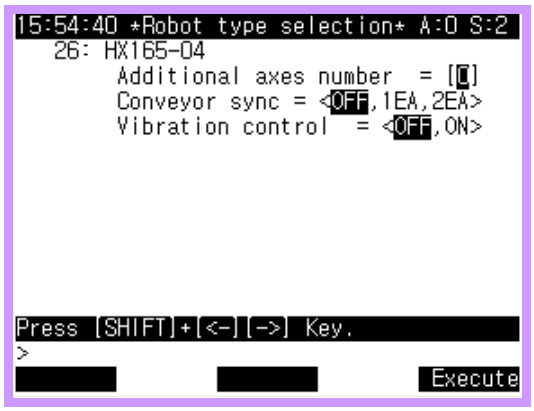
The standard of registration coordinate of additional weight about each axis is as following. The center location of S axis is the rotation center and is located on the motor height of H axis. The center location of H axis is located on the H, V axis center of motor and motor height of H axis. The center location of V axis is located on the H, V axis center of motor and the connected JOINT height of upper ARM. Direction in additional weight registration coordinate X, Y, Z of each axis has identical direction with coordinate of robot.



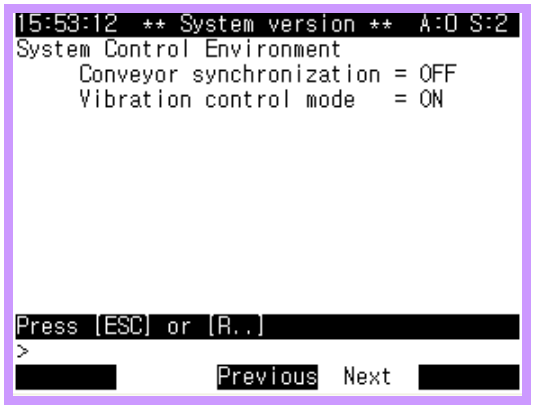
3

Confirmation and Modification of Vibration Controller Condition

On/Off of vibration controller is to decide when selecting robot type at its early stage. Use of vibration controller has to be decided according to the use of robot.



Confirmation in condition of vibration controller after its early stage, use of vibration controller can be confirmed by confirming the control environment by pressing『[PF1]: Service』→『7: System checking』→『1: System Version』→『[PF4]: Next』at the screen.



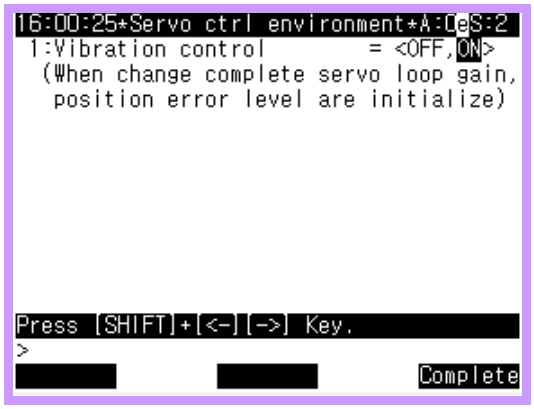
See chapter 4 about On/Off function of vibration controller when On/Off of vibration controller needs to change according to the vibration and the trajectory feature of robot as the teaching about robot operation is completed.

4

Vibration Controller On/Off Function

(Use is possible after BD411 board main software Version V10.05-06)

Additionally prepared the function to change On/Off of vibration controller due to vibration and trajectory feature of robot after teaching operational program as installing and testing robot. 『[PF2]: System』 → 『3: Machine parameter』 → 『12: Servo parameter setting』 → 『9: Servo control environment setting』 The below screen will be indicated when entering the menu.



The change of vibration controller setting is only possible at the motor OFF mode. Also, servo roof gain and location variation error level will be returned to its early stage as it fixes into the controller when setting change of vibration controller is completed. However, 『Encoder offset』, 『Axis Constant』, 『Tool data and additional-axis information』, 『Conveyor information』, and 『Accuracy』,existing data that are used will be stored because the menu of robot type selection is not re-setup.

Motor ON as it is can't be possible after changing the setting of vibration controller. Power OFF of controller and ON.

Only the feature of controller is different, so make sure to check the occurrence of interference as it can be changed a few mm from the prior condition in step travel path.

5

Application of Vibration Controller by Robot Type

In order to apply the vibration controller to the robot

(1) input dynamic modeling data of robot to the controller SW
(2) load tuning of presumption function
(3) gain tuning of vibration controller

above 3 stages are needed.

Our company is completed above 3 stages only on current HX165-02 robot. Only dynamic modeling is completed on 6 axis multi-joint robot type, so it is impossible to apply the vibration controller to HR100P or gantry robot.

Applying vibration controller by robot type is focused on our main kinds of machines and we will expand the application when the necessity is rising big or when satisfying necessity of market.

HYUNDAI
HEAVY INDUSTRIES CO.,LTD.

- **Head Office**
  Tel. 82-52-202-7901 / Fax. 82-52-202-7900
  1, Jeonha-dong, Dong-gu, Ulsan, Korea

- **A/S Center**
  Tel. 82-52-202-5041 / Fax. 82-52-202-7960

- **Seoul Office**
  Tel.82-2-746-4711 / Fax. 82-2-746-4720
  140-2, Gye-dong, Jongno-gu, Seoul, Korea

- **Ansan Office**
  Tel.82-31-409-4945 / Fax.82-31-409-4946
  1431-2, Sa-dong, Sangnok-gu, Ansan-si, Gyeonggi-do, Korea

- **Cheonan Office**
  Tel.82-41-576-4294 / Fax.82-41-576-4296
  355-15, Daga-dong, Cheonan-si, Chungcheongnam-do, Korea

- **Daegu Office**
  Tel.82-53-746-6232 / Fax.82-53-746-6231
  223-5, Beomeo 2-dong, Suseong-gu, Daegu, Korea

- **Gwangju Office**
  Tel. 82-62-363-5272 / Fax. 82-62-363-5273
  415-2, Nongseong-dong, Seo-gu, Gwangju, Korea

- **본사**
  Tel. 052-202-7901 / Fax. 052-202-7900
  울산광역시 동구 전하동 1 번지

- **A/S 센터**
  Tel. 82-52-202-5041 / Fax. 82-52-202-7960

- **서울 사무소**
  Tel. 02-746-4711 / Fax. 02-746-4720
  서울특별시 종로구 계동 140-2 번지

- **안산 사무소**
  Tel. 031-409-4959 / Fax. 031-409-4946
  경기도 안산시 상록구 사동 1431-2 번지

- **천안 사무소**
  Tel. 041-576-4294 / Fax. 041-576-4296
  충남 천안시 다가동 355-15 번지

- **대구 사무소**
  Tel. 053-746-6232 / Fax. 053-746-6231
  대구광역시 수성구 범어 2 동 223-5 번지

- **광주 사무소**
  Tel. 062-363-5272 / Fax. 062-363-5273
  광주광역시 서구 농성동 415-2 번지