

2.4 CALSET

2.4.1 What Is CALSET?

Calibrating the relationship between position-related information recognized by the robot controller and the actual position of the robot unit is called CALSET.

CALSET must be performed when the motor is replaced or when the encoder backup battery goes dead and the position-related data retained in the encoder is lost as a result.

After CALSET is completed, the calibrated data of the robot unit will be stored in the robot controller. This data is called CALSET data which is different on each robot.

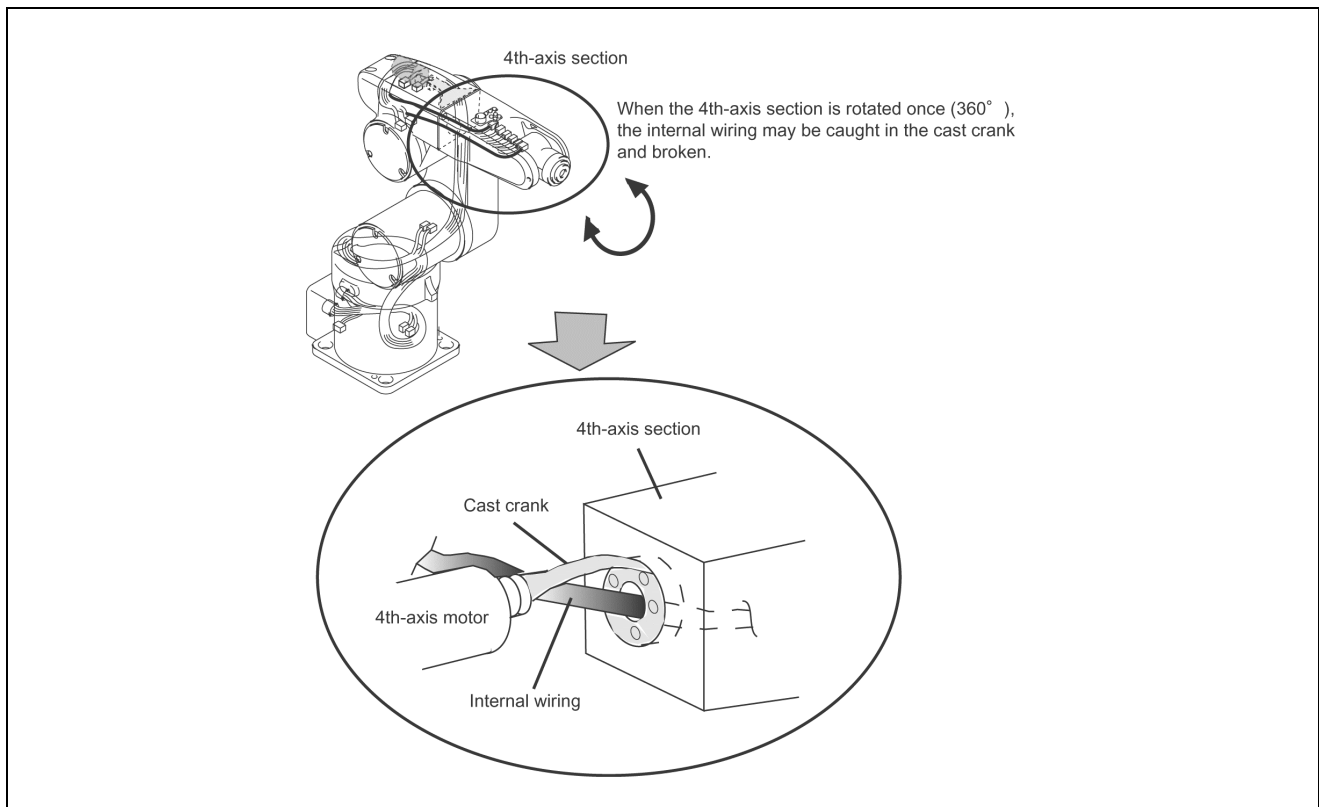
This robot has been CALSET before delivery and the CALSET data is stored in the floppy disks that come with the robot unit. Therefore, even if the memory backup battery in the robot controller dies so that the CALSET data is lost, you do not need to CALSET the robot. Just reload the CALSET data from the floppy disks.

2.4.2 Precautions about CALSET for the VM-D Series

(For models having no mechanical stop on the 4th-axis)

Robots in the VM-6083D/VM-60B1D series launched after March, 2001 have **no mechanical stop on the 4th-axis**.

If the 4th-axis CALSET position is wrongly set by one rotation (360°) while CALSET is being carried out, the internal wiring may be caught in the crank and broken. To carry out CALSET with a robot with no 4th-axis mechanical stop, check the normal 4th-axis position first as described below.

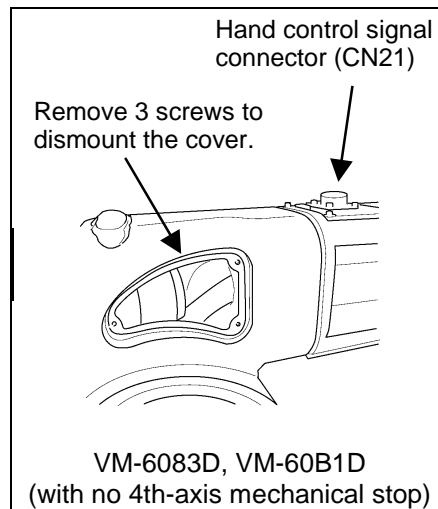


Note that turning the 4th-axis section by more than 360° may break the internal wiring

Checking of 4th-axis Position before Carrying Out CALSET

- (1) Manually move the 4th-axis section until the hand control signal connector comes to the upper side.
- (2) Dismount the cover from the second arm so that the internal wiring can be checked.

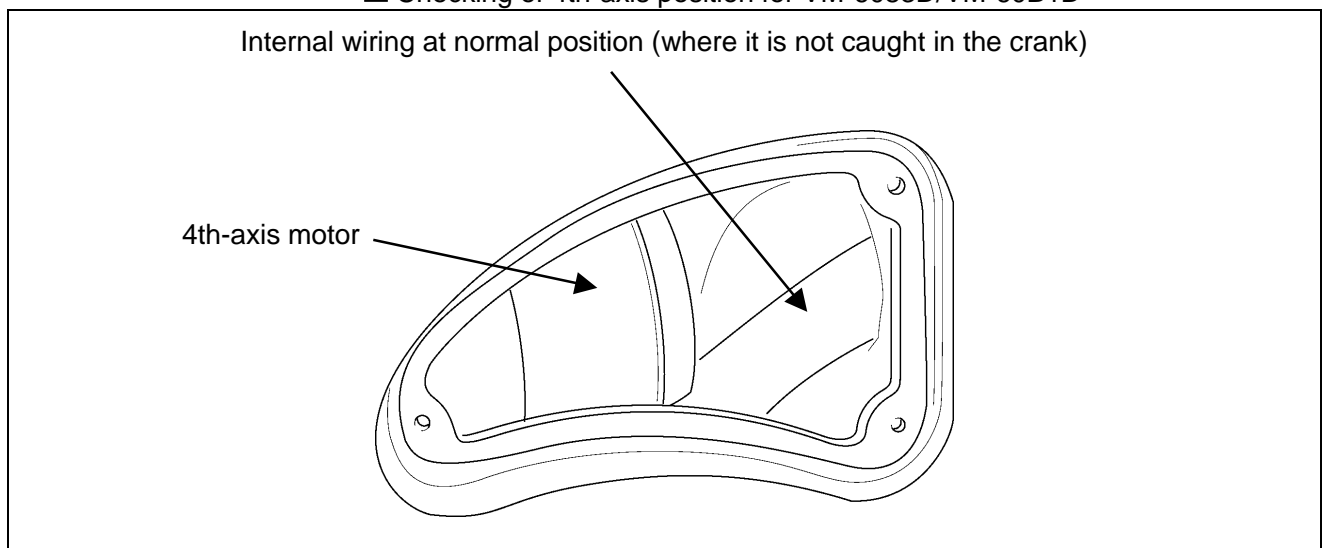
The cover to dismount for each model is shown below:



- (3) Check that the 4th-axis section is at a designated position.

(The hand control signal connector (CN21) of the second arm comes to the upper side and the internal wiring is not caught in the crank at this time.)

■ Checking of 4th-axis position for VM-6083D/VM-60B1D



- (4) When the 4th-axis section is not at the normal position, manually move it to a designated position.

Preparation before carrying out CALSET is finished now.

NOTE: If the step [2.4.2] is omitted, the 4th-axis CALSET position may be mistaken by one rotation (360°). The internal wiring may be caught in the crank and broken in such a case.

2.4.3 Preparation for CALSET

In all models, the 1st, 2nd, 3rd, and 5th axes are equipped with mechanical stops but the 6th axis is not.

As for the 4th axis, whether it is equipped with a mechanical stop or not depends upon the model and manufacturing date as listed below. That is, the VM-6083D/VM-60B1D manufactured after the middle of March in 2001 (**Note 1**) and the VS-E series have no mechanical stop on the 4th axis.

To CALSET those axes having no mechanical stop, you need to mount a CALSET jig before starting CALSET as described on the following pages.

Mechanical Stops on Axes

Model	On the 1st, 2nd, 3rd, 5th axes	On the 4th axis	On the 6th axis
VM-6070D	Mechanical stops provided	Mechanical stop provided	No mechanical stops
VM-6083D/VM-60B1D manufactured before the middle of March in 2001		Mechanical stop provided (Note 1)	
VM-6083D/VM-60B1D manufactured after the middle of March in 2001		No mechanical stop (Note 1)	

(Note 1) To distinguish between the VM-6083D/VM-60B1D having a mechanical stop on the 4th axis and that having no mechanical stop, check the presence of a notch in the figure on page 77. If there is a notch, the model has no mechanical stop on the 4th axis.

(1) If your model has a mechanical stop on the 4th axis

Press each of the 1st to 5th axes manually against the associated mechanical stop and get the actual position.

Since the 6th axis has no mechanical stop, you need to mount a CALSET jig to set a temporary mechanical end for CALSET. Then press the 6th axis against this mechanical end and get the position. When CALSETing the 6th axis, you need to press also the 5th axis against the mechanical stop since CALSET requires the positional relationship between the 5th and 6th axes.

(2) If your model has no mechanical stop on the 4th axis

Press each of the 1st, 2nd, 3rd, and 5th axes manually against the associated mechanical stop and get the actual position.

Since the 4th and 6th axes have no mechanical stop, you need to mount a CALSET jig to set a temporary mechanical end for CALSET. Then press the 4th and 6th axes against those mechanical ends and get the those positions. When CALSETing the 6th axis, you need to press also the 5th axis against the mechanical stop since CALSETing requires the positional relationship between the 5th and 6th axes.

(3) Cautions at CALSET

CALSET requires some space for bringing each axis into contact with the mechanical end.

Caution (1) When CALSETing, move the axis to be CALSET in the vicinity of the mechanical stop, release the brake, and bring the axis into contact with the mechanical stop.

- The VM-D/VS-E series may release the brake of the specified axis, but the VS-D series will release brakes of all axes.
- VM-D series and the brake-equipped version of the VS-D/-E series: Each of the 2nd through 6th axes has a brake.
- None-brake version of the VS-D series: Only the 2nd and 3rd axes have brakes.
- None-brake version of the VS-E series: Only the 2nd to 4th axes have brakes.

(2) When performing CALSET, be careful with the robot motion. The execution of the CALSET command releases motor brakes so that the robot arms will move by its own weight.

(3) After CALSET, confirm in the manual mode that each axis stops at the software motion limit before coming into contact with the mechanical end.

(4) In automatic operation, start to run the robot at low speed. Ensuring safety, gradually increase the speed. It makes adjustment easy.

(5) Position-related data in some programs made before CALSET may vary somewhat after CALSET.

(6) For models having no mechanical stop on the 4th axis:

When rotating the 4th axis with the brake released, take care not to let the 4th axis override the motion limit (initial setting of the software motion limit). Rotating it beyond the motion limit will cause the brake (even released) to be locked, turning the motor off.

Be careful with arms that may rotate by gravity after brakes are released depending upon the robot posture and hand position.

2.4.4 Mounting the CALSET Jig

To CALSET the 6th axis on all models or the 4th axis on models having no mechanical stop, you need to mount the CALSET jig on the axis beforehand according to the procedure given in (1) below or (2) given later, respectively.

To CALSET all axes including the above axes., follow those procedures (1) and (2).

(1) Mounting the CALSET jig on the 6th axis

► STEP 1

Fit a stopper pin in the CALSET jig.

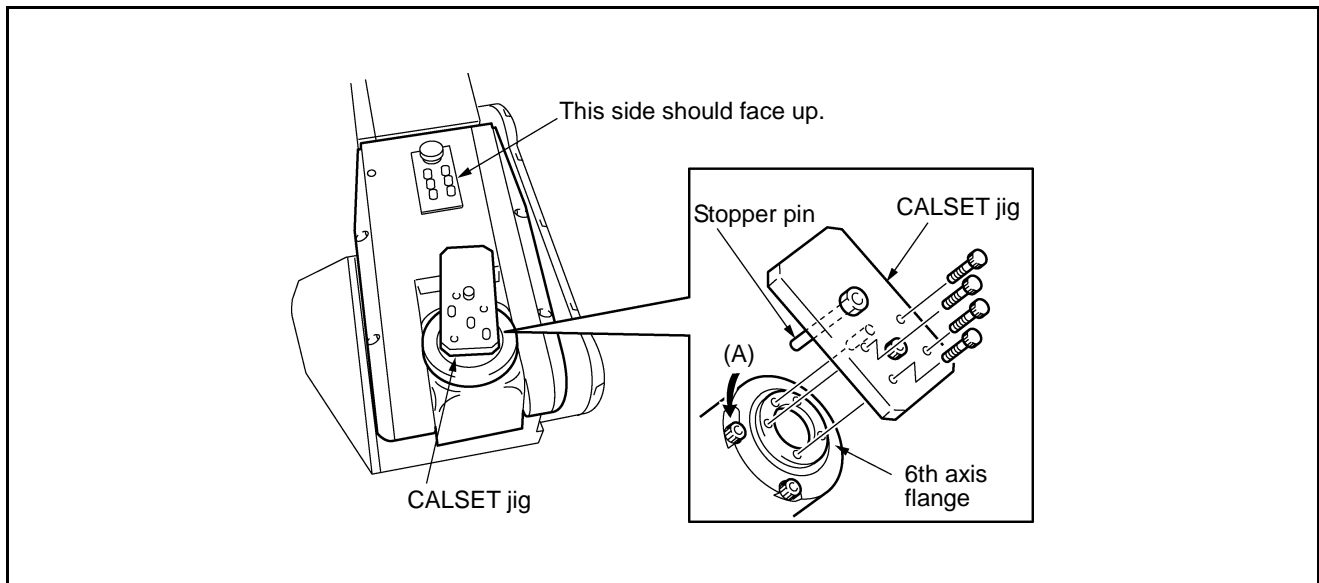
► STEP 2

Release the brake of the 6th axis.

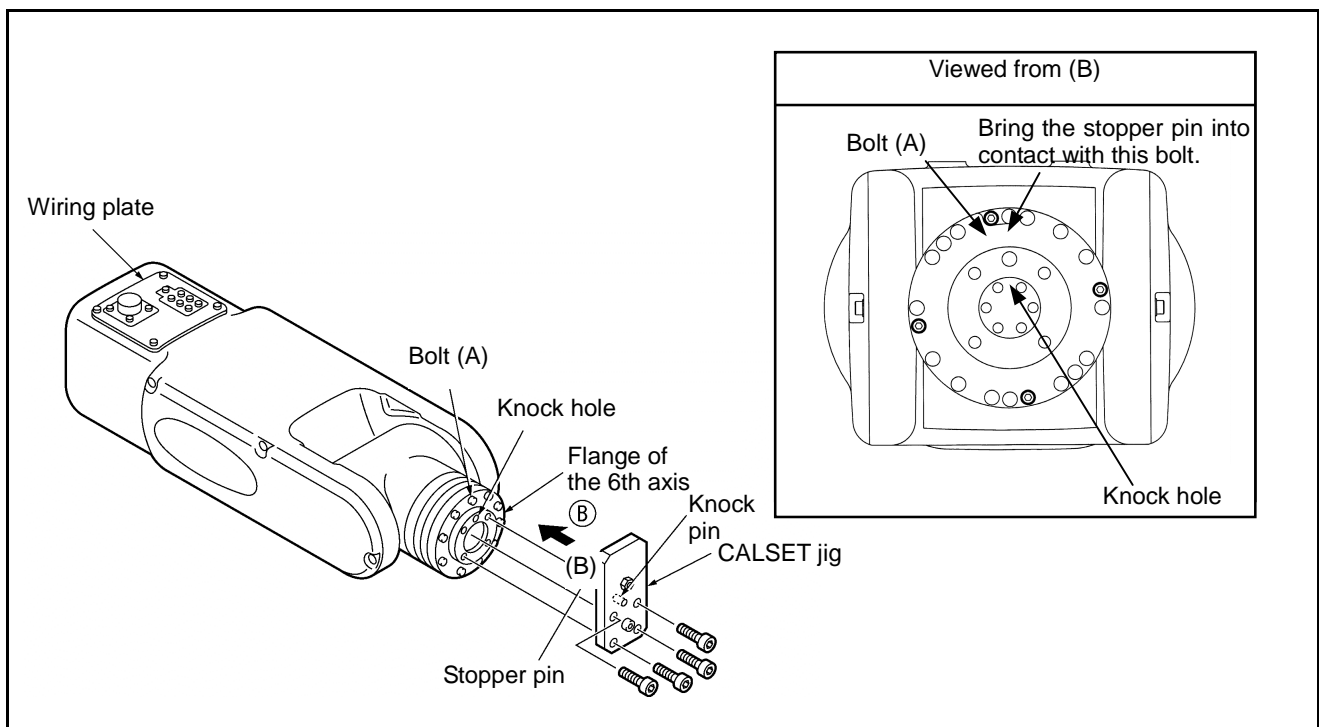
► STEP 3

Install the CALSET jig on the flange of the 6th axis as shown in the figure below and the figure on the next page.

TIP: The CALSET position of the 6th axis refers to the point where the stopper pin (shown in the lower figures and the figure on the next page) comes into contact with bolt (A) when the flange of the 6th axis is turned.



Mounting a CALSET Jig [VM-6070D]



Mounting a CALSET Jig [VM-6083D/VM-60B1D]

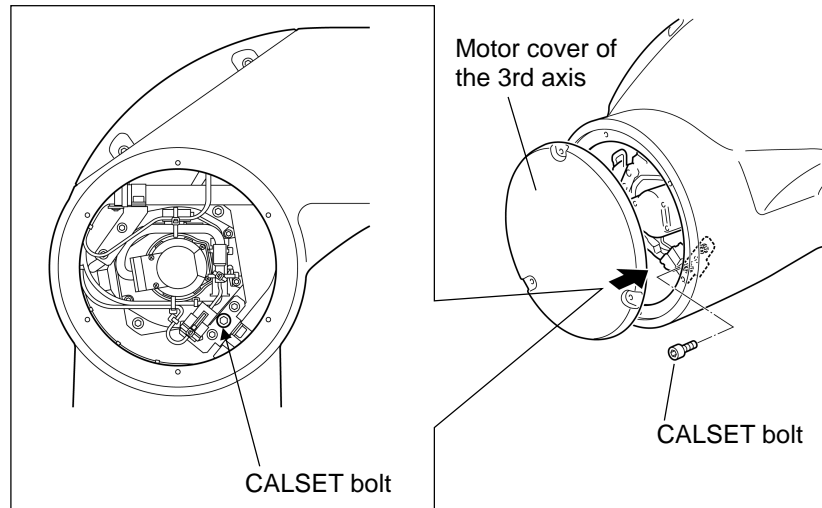
(2) Mounting the CALSET jig on the 4th axis

As a CALSET jig, a special bolt (CALSET bolt) is provided inside the 3rd-axis motor cover in the robot unit.

► STEP 1

Remove the 3rd-axis motor cover and unscrew the CALSET bolt.

NOTE: After CALSETing, be sure to set the bolt back into place and torque it to 1.0 Nm \pm 20%.



Removing the CALSET Bolt (VM-6083D/VM-60B1D)

► STEP 2

Rotate the second arm to the position specified in STEP 4.

► STEP 3

Release the brake of the 4th axis.

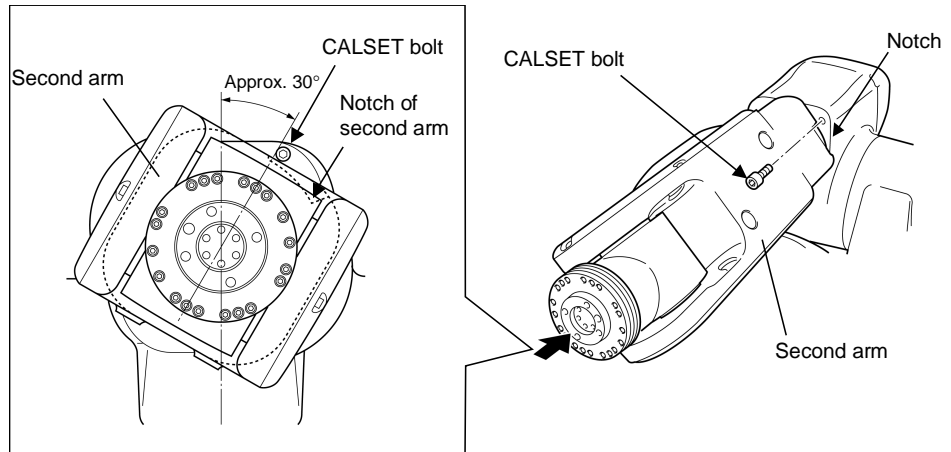
► STEP 4

Set the CALSET bolt to the end of the 3rd axis housing as shown in Figure 4-16.

Tightening torque of the CALSET bolt: $2.9 \text{ Nm} \pm 20\%$

NOTE: Be sure to use the CALSET bolt as a CALSET jig. Using any other bolt will result in a positional error in CALSET.

TIP: The CALSET position of the 4th axis refers to the point where the notch of the second arm comes into contact with the head of the CALSET bolt by turning the second arm.



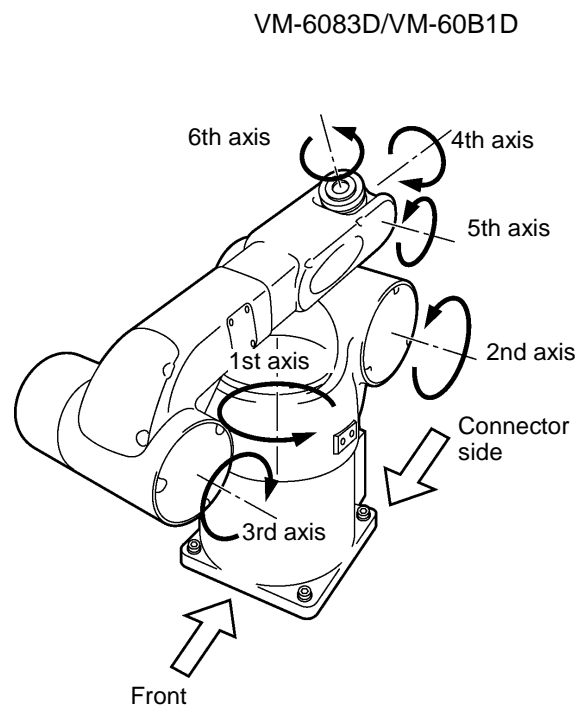
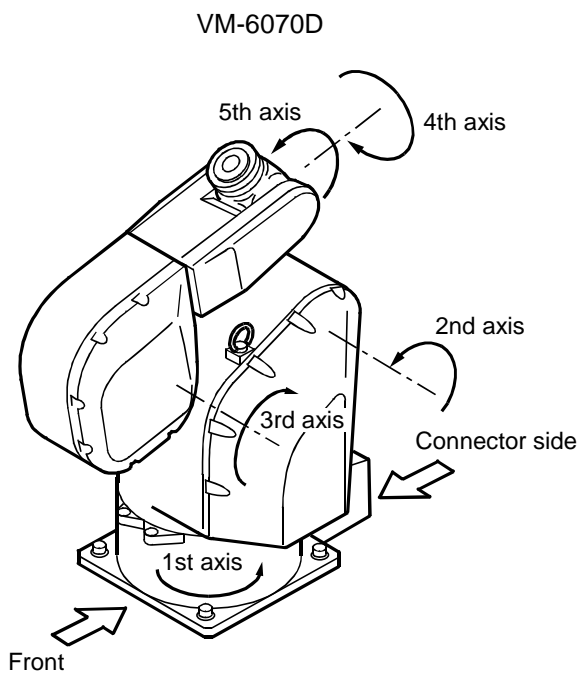
Mounting the CALSET Bolt (VM-6083D/VM-60B1D)

2.4.5 What Is a CALSET Position?

The limit position of an arm to be CALSET is called a CALSET position.

Each axis has a mechanical end in each of the positive and negative directions. The mechanical ends shown in the figure below are the CALSET positions.

Axis		CALSET positions
Position	1st axis	Turning end in the positive direction (counterclockwise end when viewed from top)
	2nd axis	Turning end in the negative direction
	3rd axis	Turning end in the positive direction
	4th axis	<u>Models having a mechanical stop on the 4th axis</u> Turning end in the positive direction (counterclockwise end when viewed from the arm end) <u>Models having no mechanical stop on the 4th axis</u> Turning end in the positive direction, which is set by a CALSET jig. (See Section 2.4.4) (counterclockwise end when viewed from the arm end)
	5th axis	Turning end in the positive direction (upward end of the 5th-axis arm)
	6th axis	Turning end in the positive direction, which is set by a CALSET jig. (See Section 2.4.4)



CALSET Positions (VM-D series)

2.4.6 CALSET Procedure

2.4.6.1 CALSETing a Single Axis

CALSETing a specified single axis only is called single-axis CALSET.

Perform single-axis CALSET if the motor of an axis is replaced so that the axis must be CALSET, or if some axes cannot be moved to the CALSET positions (mechanical stop positions) at any given time because of interference between the robot unit and its surrounding facilities.

NOTE: Step 1 is required for CALSETing the 4th and 6th axes and Step 2 is for CALSETing the 6th axis. When CALSETing any other axes, skip to Step 3.

► STEP 1

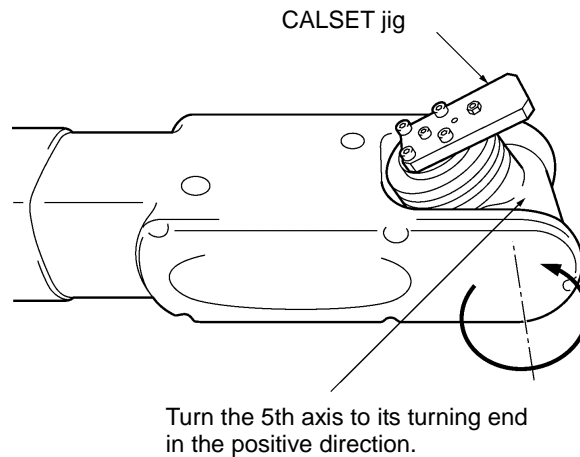
(Required for CALSETing the 4th and 6th axes)

Mount the CALSET jig according to Subsection 2.4.2.1 "Mounting the CALSET Jig."

► STEP 2

(Required for CALSETing the 6th axis)

Fully turn the 5th axis to its turning end in the positive direction.



► STEP 3

Turn the power switch of the robot controller to ON.

► STEP 4

Set the mode selector switch of the teach pendant to MANUAL.

► STEP 5

Press MOTOR to turn ON the power to the motor.

► STEP 6

Move the axis to be CALSET in the vicinity of the mechanical stop via the manual operation from the teach pendant.

► STEP 7

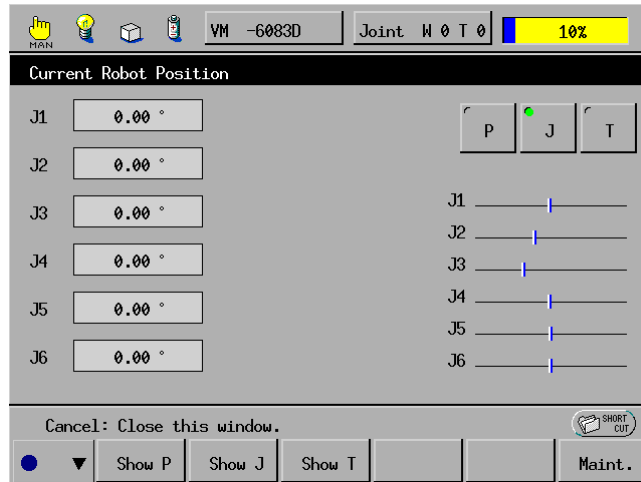
Press the MOTOR key on the teach pendant to turn OFF the power to the motor.

► STEP 8

Press [F2 Arm] on the teach pendant.

► STEP 9

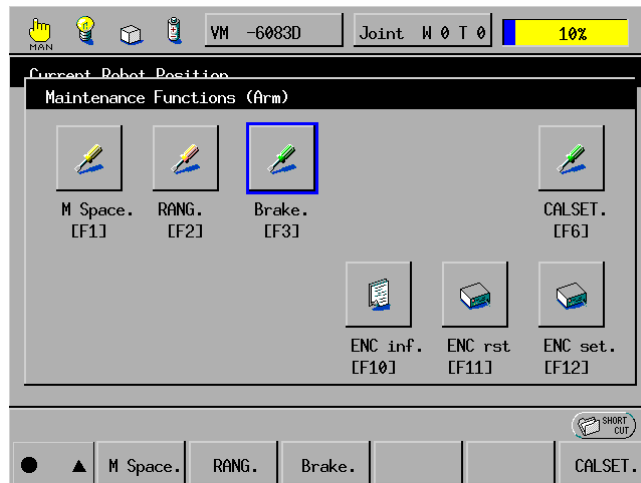
Press the SHIFT key and [F12 Maint.].



F12

► STEP 10

Press [F3 Brake.].

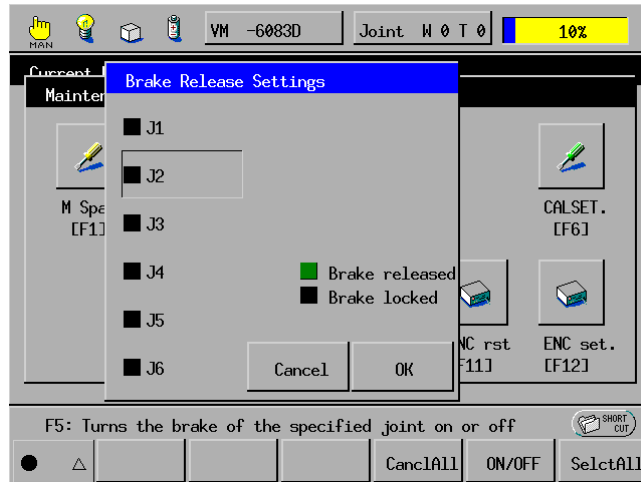


F3

► STEP 11

■ VM-D/VS-E Series

Touch the axis number to be CALSET to select "Brake released" (green display).



► STEP 12

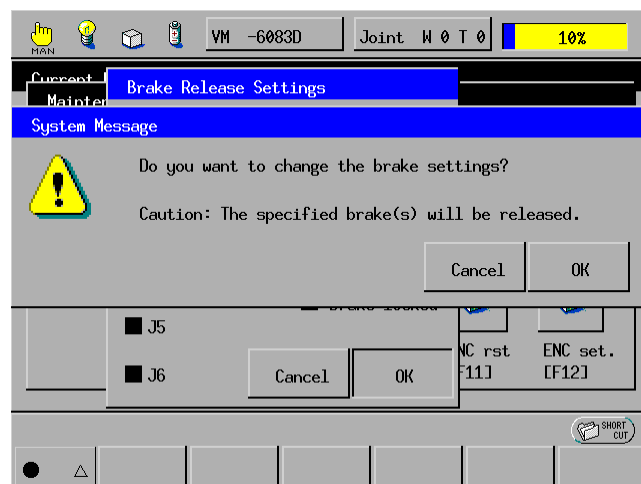
Confirm that there is no danger even if the arms fall as a result of released brakes.

CAUTION: The brake of the specified axis is released in the VM-D/VS-E series.

► STEP 13

Press OK.

The system message appears asking you whether you want to change the brake settings.

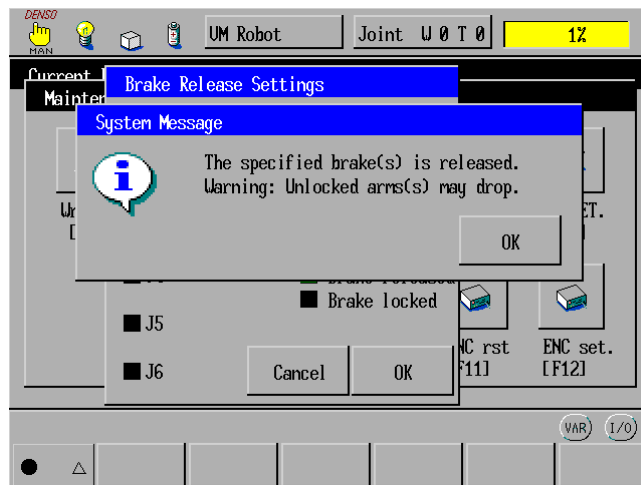


► STEP 14

■ VM-D/VS-E Series

Press OK.

The system message appears informing that the brake is released and warning against drop of arms.



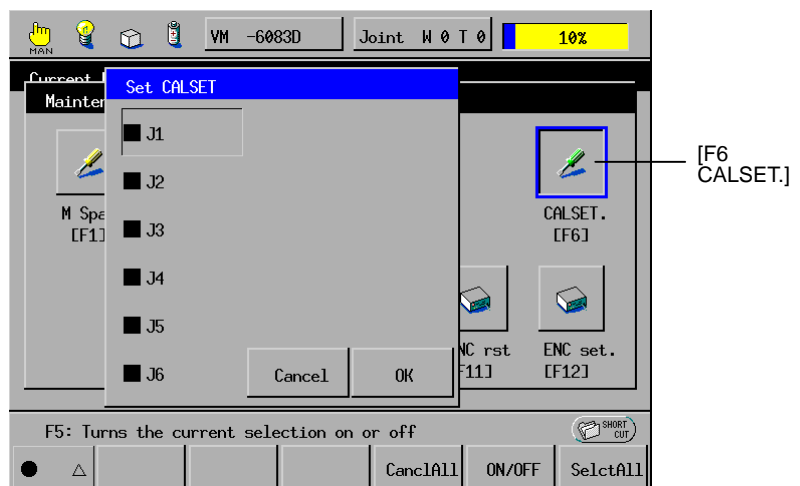
► STEP 15

Press the axis to be CALSET against the mechanical stop by hand.

► STEP 16

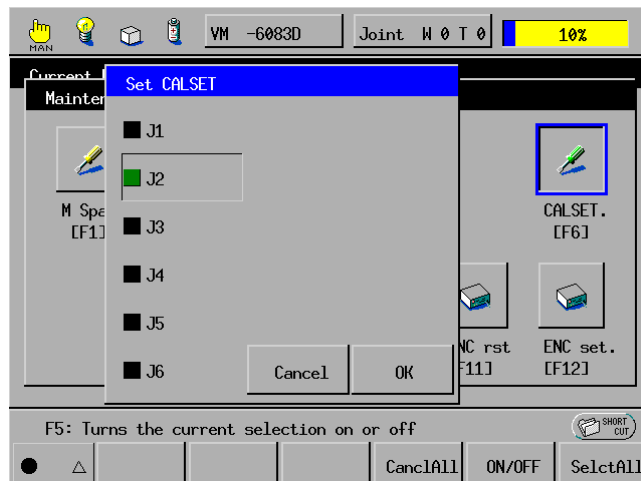
Press [F6 CALSET.].

The Set CALSET window appears.



► STEP 17

Press the axis number to be CALSET to select CALSET (green display). Deselect CALSET (black display) for the other axes that are not required to be CALSET.



► STEP 18

Press OK.

The system message appears asking whether you want to carry out CALSET and showing a caution that the robot reference position will change.



► STEP 19

Press OK.

The system message appears informing that CALSET is completed.

► STEP 20

Press the ROBOT STOP button.
The robot brake becomes activated.

► STEP 21

Turn the ROBOT STOP button to cancel robot stop.

► STEP 22

Press the MOTOR to turn ON the power to the motor.

Caution: A "motor lock overload" error may occur just after the power to the motor is turned ON. In this case, try to turn ON the power several times, or release the brake, move the axis a little in the opposite direction of the mechanical end, and turn ON the power again.

► STEP 23

Move the CALSETed axis in the opposite direction from the mechanical end by the manual operation of the teach pendant.

► STEP 24

Perform CAL. The single-axis CALSET of the specified axis is completed.

2.4.6.2 CALSETing All Axes

The CALSET of all axes is called all-axis CALSET.

The procedure is the same as that for single-axis CALSET except that you should select all axes for brake release and CALSET in Steps 9, 13 and 15. For details of the procedure, see Subsection 2.4.6.1 "CALSETing a Single Axis."