GFZ-61443EN-2 B-61443EN-2

GE Fanuc CNC

Series 16/18/21 and 16i/18i/21i Connection Manual (Loader Control)

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FANUC

GE Fanuc Automation

Computer Numerical Control Products

Series 16 / 18 / 21
Series 16i / 18i / 21i

Connection Manual (Loader Control))

GFZ-62443EN-2/03 *August 1997*

Warnings, Cautions, and Notes as Used in this Publication

Warning

Warning notices are used in this publication to emphasize that hazardous voltages, currents, temperatures, or other conditions that could cause personal injury exist in this equipment or may be associated with its use.

In situations where inattention could cause either personal injury or damage to equipment, a Warning notice is used.

Caution

Caution notices are used where equipment might be damaged if care is not taken.

Note

Notes merely call attention to information that is especially significant to understanding and operating the equipment.

This document is based on information available at the time of its publication. While efforts have been made to be accurate, the information contained herein does not purport to cover all details or variations in hardware or software, nor to provide for every possible contingency in connection with installation, operation, or maintenance. Features may be described herein which are not present in all hardware and software systems. GE Fanuc Automation assumes no obligation of notice to holders of this document with respect to changes subsequently made.

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DEFINITION OF WARNING, CAUTION, AND NOTE

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.**

PREFACE

The Series 16/18/21 supports a loader control option that enables one control unit to independently control both a machine and loader at the same time. This option can be used with the CNC products listed below.

This manual is aimed at those users who intend to control a loader with a CNC. It outlines the loader control option, and describes its connection, operation, and maintenance. This manual assumes the reader to be familiar with the standard Series 16, 18, or 21. If required, refer also to the Series 16/18/21 manuals listed below.

Applicable CNC units:

Product name	Abbreviations	
FANUC Series 16–TA	16–TA	Series 16
FANUC Series 16–TTA	16–TTA	
FANUC Series 16–GCA	16–GCA	
FANUC Series 16–MB	16–MB	
FANUC Series 16–TB	16–TB	
FANUC Series 160–MB	160–MB	
FANUC Series 160–TB	160–TB	
FANUC Series 16–MC	16–MC	
FANUC Series 16–TC	16–TC	
FANUC Series 160–MC	160–MC	
FANUC Series 160–TC	160–TC	
FANUC Series 16*i*–A	16*i*–A	Series 16*i*
FANUC Series 160*i*–A	160*i*–A	
FANUC Series 18–TA	18–TA	Series 18
FANUC Series 18–TTA	18–TTA	
FANUC Series 18–GCA	18–GCA	
FANUC Series 18–MB	18–MB	
FANUC Series 18–TB	18–TB	
FANUC Series 180–MB	180–MB	
FANUC Series 180–TB	180–TB	
FANUC Series 18–MC	18–MC	
FANUC Series 18–TC	18–TC	
FANUC Series 180–MC	180–MC	
FANUC Series 180–TC	180–TC	
FANUC Series 18*i*–A	18*i*–A	Series 18*i*
FANUC Series 180*i*–A	180*i*–A	
FANUC Series 21–TB	21–TB	Series 21
FANUC Series 21*i*–A	21*i*–A	Series 21*i*
FANUC Series 210*i*–A	210*i*–A	

In this manual, T series and M series refer to the loader control option connected to the products indicated below.

T series	16–TA/16–TTA/16–GCA 18–TA/18–TTA/18–GCA 16–TB/18–TB 160–TB/180–TB 16–TC/18–TC 160–TC/180–TC 16*i*–TA/18*i*–TA 160*i*–TA/180*i*–TA 21–TB 21*i*–TA/210*i*–TA
M series	16–MB/18–MB/160–MB/180–MB 16–MC/18–MC/160–MC/180–MC 16*i*–MA/18*i*–MA/21*i*–MA 160*i*–MA/180*i*–MA/210*i*–MA

Relative manuals

Series 16/18–MODEL A

FANUC Series 16/18	DESCRIPTIONS	B-61802E
FANUC Series 16/18	CONNECTION MANUAL	B-61803E
FANUC Series 16/18 For Lathe	OPERATOR'S MANUAL	B-61804E
FANUC Series 16/18	MAINTENANCE MANUAL	B-61805E
FANUC Series 16/18	PARAMETER MANUAL	B-61810E

Series 16/18/160/180–MODEL B

FANUC Series 16/18/160/180–MODEL B	DESCRIPTIONS	B-62442E
FANUC Series 16/18/160/180–MODEL B	CONNECTION MANUAL (Hardware)	B-62443E
FANUC Series 16/18/160/180–MODEL B	CONNECTION MANUAL (Function)	B-62443E–1
FANUC Series 16/18/160/180–TB	OPERATOR'S MANUAL	B-62444E
FANUC Series 16/18/160/180–MB	OPERATOR'S MANUAL	B-62454E
FANUC Series 16/18/160/180–MODEL B	MAINTENANCE MANUAL	B-62445E
FANUC Series 16/18/160/180–MODEL B	PARAMETER MANUAL	B-62450E

Series 16/18/160/180–MODEL C

FANUC Series 16/18/160/180–MODEL C	DESCRIPTIONS	B-62752EN
FANUC Series 16/18/160/180–MODEL C	CONNECTION MANUAL (Hardware)	B-62753EN
FANUC Series 16/18/160/180–MODEL C	CONNECTION MANUAL (Function)	B-62753EN-1
FANUC Series 16/18/160/180–TC	OPERATOR'S MANUAL	B-62754EN
FANUC Series 16/18/160/180–MC	OPERATOR'S MANUAL	B-62764EN
FANUC Series 16/18/160/180–MODEL C	MAINTENANCE MANUAL	B-62755EN
FANUC Series 16/18/160/180–MODEL C	PARAMETER MANUAL	B-62760EN

Series 16*i*/18*i*/160*i*/180*i*–MODEL A

FANUC Series 16*i*/18*i*/21*i*/160*i*/180*i*/210*i*–MODEL A	DESCRIPTIONS	B–63002EN
FANUC Series 16*i*/18*i*/160*i*/180*i*–MODEL A	CONNECTION MANUAL (Hardware)	B–63003EN
FANUC Series 16*i*/18*i*/21*i*/160*i*/180*i*/210*i*–MODEL A	CONNECTION MANUAL (Function)	B–63003EN–1
FANUC Series 16*i*/18*i*/160*i*/180*i*–TA	OPERATOR'S MANUAL	B–63004EN
FANUC Series 16*i*/18*i*/160*i*/180*i*–MA	OPERATOR'S MANUAL	B–63014EN
FANUC Series 16*i*/18*i*/160*i*/180*i*–MODEL A	MAINTENANCE MANUAL	B–63005EN
FANUC Series 16*i*/18*i*/160*i*/180*i*–MODEL A	PARAMETER MANUAL	B–63010EN

Series 21–TB

FANUC Series 21/210	DESCRIPTIONS	B-62702EN
FANUC Series 21/210	CONNECTION MANUAL (Hardware)	B-62703EN
FANUC Series 21/210	CONNECTION MANUAL (Function)	B-62703EN–1
FANUC Series 21/210–TB	OPERATOR'S MANUAL	B-62534E
FANUC Series 21/210	MAINTENANCE MANUAL	B-62705EN
FANUC Series 21/210	PARAMETER MANUAL	B-62710EN

Series 21*i*/210*i*–MODEL A

FANUC Series 16*i*/18*i*/21*i*/160*i*/180*i*/210*i*–MODEL A	DESCRIPTIONS	B–63002EN
FANUC Series 21*i*/210*i*–MODEL A	CONNECTION MANUAL (Hardware)	B–63083EN
FANUC Series 16*i*/18*i*/21*i*/160*i*/180*i*/210*i*–MODEL A	CONNECTION MANUAL (Function)	B–63003EN–1
FANUC Series 21*i*/210*i*–TA	OPERATOR'S MANUAL	B–63084EN
FANUC Series 21*i*/210*i*–MA	OPERATOR'S MANUAL	B–63094EN
FANUC Series 21*i*/210*i*–MODEL A	MAINTENANCE MANUAL	B–63085EN
FANUC Series 21*i*/210*i*–MODEL A	PARAMETER MANUAL	B–63090EN

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1 OVERVIEW

1.1 SYSTEM CONFIGURATION

The loader control option is connected to the Series 16/18/21 as shown below.

Axis control for the machine is performed by the main CPU board, while that for the loader is performed by a dedicated Loader Control Board (LCB). The PMC of the main CPU unit (option 3 board when a PMC–RC is used) controls the machine, while the PMC of the LCB controls the loader. Input/output signals are stored in the LCB, and are fed directly to the main loader unit, workpiece feeder, and loader operator's panel.

The major tasks involved in building this system are:

(1) Adding the loader control board (LCB) to the CNC (using one slot exclusively).

(2) Mounting and wiring servo amplifiers and an emergency stop control circuit in the power magnetics cabinet.

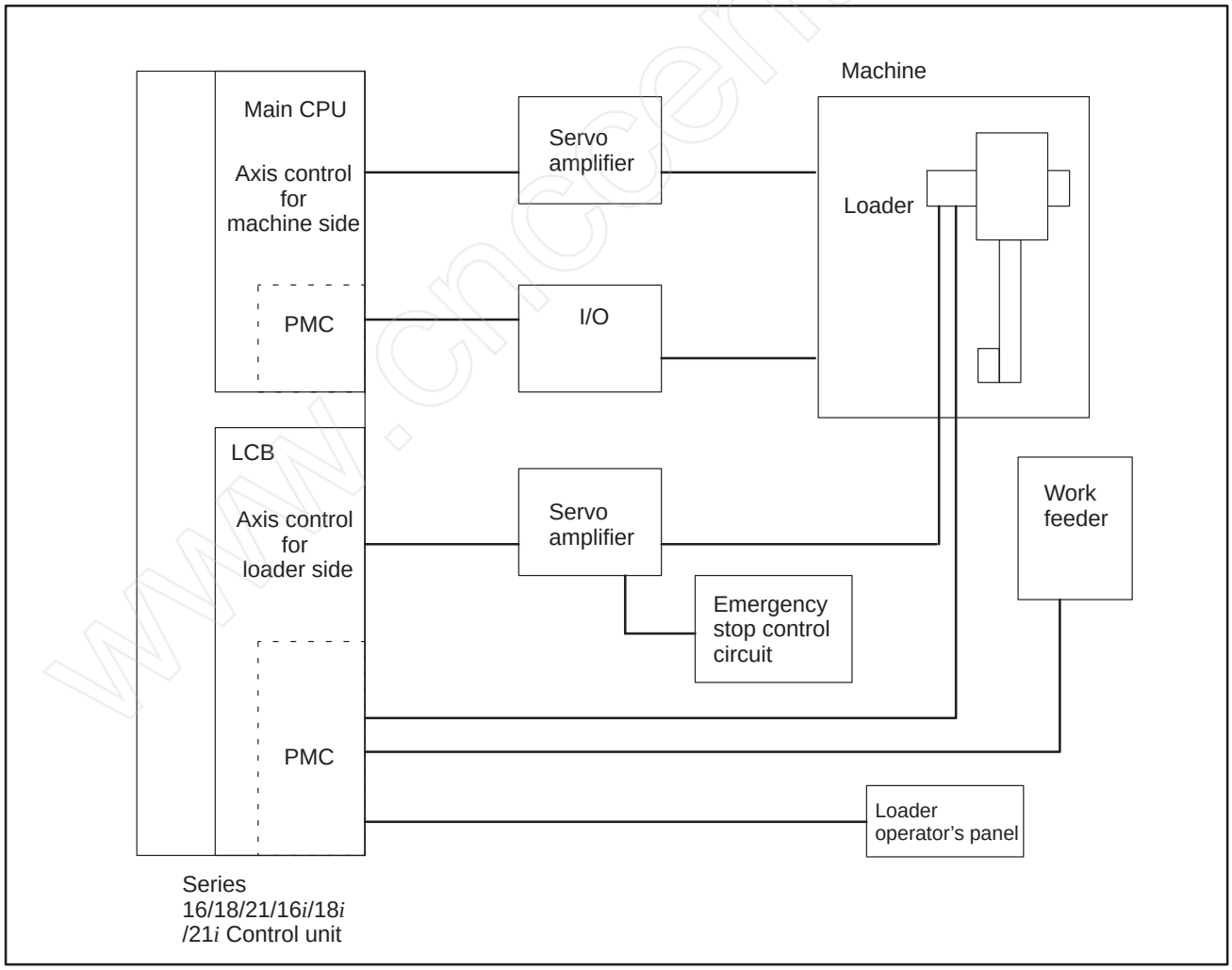
(3) Connecting the loader to the workpiece feeder via cables.

(4) Connecting the operator's panel.

(5) Creating loader control related functions by using PMC programs.

(6) Creating palletizing and teaching functions by using macros.

(7) Creating (teaching) the loader operation programs.



1.2 INSTALLING THE LOADER CONTROL FUNCTIONS

When the loader control option is installed and used in a system, sequence control is required to enable interfacing with the peripherals, as well as for loader operation. Generally, the required control specifications vary from one system to another. So, the functions required for each system must be installed. In practice, the PMC and macro executor are used to implement the required functions.

The PMC that is built into the loader control board performs the sequence logic required to control the loader. The PMC supports functions equivalent to the PMC–RA1 of the Series 18.

Between the loader control CPU and the PMC, an F/G area interface is provided, in the same way as for an ordinary CNC. The loader supports modes similar to those supported by an ordinary NC. For example, manual mode must be set for manual loader operation, and memory mode must be set for automatic loader operation. In addition, a specified speed can be overridden by entering the DI override signal. Thus, loader operation requires the use of ladder programs, in the same way as an ordinary NC.

The PMC is also used to enable synchronous operation of the machine and loader. For example, the PMC is used to start the loader when machining ends, and to start machining once the loader has fed the workpiece into the chuck of the machine.

Using custom macros or a macro executor, very complicated loader axis operations, such as workpiece palletizing/depalletizing, can be programmed easily. In some cases, complicated workpiece feeder control operations can be simplified by using macros. Macro–based control reduces the number of PMC steps, making macro–based control advantageous even when the PMC is being used at maximum capacity. Even for macro–based control, however, DI/DO signal transfer must be programmed using the PMC. Note that the loader control macro programs are provided in a ROM module in the case of the Series 16/18–MODEL A, and in an FROM (flash memory) module in the case of the Series 16/18–MODEL B/C. The ROM or FROM module is installed on the loader control board.

In the case of the Series 21, the loader control macro programs are provided in an FROM (flash memory) module, installed on the main board.

In the case of the Series 16*i*/18*i*/21*i*, the loader control macro programs are provided in an FROM (flash memory) module, installed on the motherboard.

The following table lists typical operations to which the PMC and macro executor can be applied.

	PMC	Macro executor
Loader operations (such as mode setting, activation, and overriding)	○	
Control of the loader mechanical unit (such as braking)	○	
Hand control (such as open/close, air blow)	○	
Operations that must be synchronized with the machine (such as activation and waiting)	○	
Workpiece feeder control	○	(○)
Palletizing/depalletizing		○
Loader operator's panel	○	
Customized program screen		○

The DI/DO signals listed below are used for loader control. These DI/DO signals are stored in the loader control board. In an application system that requires additional DI/DO signals, an I/O link interface is available to enable external I/O expansion.

The loader control board of the Series 16*i*/18*i*/21*i* does not use these DI/DO signals. All DI/DO signals are connected via an I/O link interface to an external input/output unit.

Loader control (overtravel, hand open/close, air on/ off, etc.)

Workpiece feeder control (moving the workpiece feeder back and forth)

Loader operator's panel control (teaching, emergency stop)

Brake control (brake application for emergency stop)

1.3 TABLE OF SPECIFICATIONS

Item	Specifications
Controlled axis	Up to a maximum of 4 axes at a time (up to 4 axes are allowed as standard)
Part program storage length	10m 20m (option 1) 40m (option 2) 80m (option 3)
Programs	Up to 63 programs can be registered.
PMC	PMC–RA1 Number of ladder steps 3000 (option 4) 4500 (option 5) . . For Series 16/18–MODEL A 5000 (option 5) . . . For Series 16/18–MODEL B/C, Series 21TB,Series 16*i*/18*i*/21*i*
RS–232–C	Channel 1 of the main CPU board is used. (option 6) Floppy cassette directory indication (option 7)
Manual handle	For first unit (option 8) For second unit (option 9) For third unit (option 9) (Only for M series) MPG of the main CPU board is used. (For Series 16/18) MPG of the I/O board is used. (For Series 21) MPG of the motherboard is used. (For Series 16*i*/18*i*/21*i*)
G code system (T series only)	G code system A No G code system is used with the M series.
Axis name	X, Y, Z, A, B, C (M series, T series) U, V, W (Only for M series) The T series is used with G code system A, such that U, V, and W are used as addresses for incremental commands.
Command and type (M series only)	Incremental command G90 Absolute command G91
Plane selection	XpYp Plane selection G17 ZpXp Plane selection G18 YpZp Plane selection G19
Input unit	Metric or inch system can be selected by parameter specification. Inch/metric switch G20/G21 (option 10)
Increment system	0.001mm, 0.001deg or 0.0001inch (IS–B)
Rapid traverse (positioning)	Positioning G00 Positioning, either of non–interpolation type or linear interpolation type, can be selected by specifying a parameter.

Item		Specifications
Cutting feed		Linear interpolation G01 Circular interpolation G02, G03 Cutting feedrate clamp Feed per minute
Override		Manual feedrate override Rapid traverse override Rapid traverse override 1% step Feedrate override 2nd feedrate override (option 11) The Series 21, Series 21*i* does not support the 2nd feedrate override function.
Automatic acceleration deceleration	Rapid traverse G00	Linear acceleration/deceleration Bell–shaped acceleration/deceleration (option 12)
	Cutting feed G01	Exponential acceleration/deceleration Linear acceleration/deceleration after interpolation (option 13) ... For Series 16*i*/18*i*
Dwell		Dwell G04
Reference position return		Automatic reference position return G28 Reference position return check G27 2nd reference position return G30 3rd, 4th reference position return (option 14) Manual reference position return
Coordinate system		Coordinate system selection G92 (M series), G50 (T series) Automatic coordinate system setting Workpiece coordinate system shift Direct input coordinate system shift Machine coordinate system selection G53 (option 15) Local coordinate system G52 (option 15) Workpiece coordinate system G54 to G59 (option 15)
Decimal point input		Decimal point input Pocket calculator type decimal point input
Optional block skip		Signal BDT1 Signal BDT2 to BDT9 (option 16)
Compensation function		Backlash compensation Pitch error compensation max/1024 points (option 17)
Measurement		SKIP function SKIP signal
Auxiliary function		Auxiliary function (M function) 1 block multiple M command
Programmable parameter input		G10 (option 18) G11

Item	Specifications
Macro	Macro executer (option 19) Custom macro B (option 20) Common variables addition (macro B) (option 21) Interruption type custom macro (option 22)
Editing	Playback function (option 23) Extended part program (option 24)
Language display	English Japanese (option 25)
Automatic operation	If the NC issues an alarm, automatic operation is not activated. Note, however, that automatic operation of the NC is not affected by an alarm issued by the loader.
Overtravel stroke limit	Hardware OT (can be disabled by parameter setting) Stored stroke limit 1 Stored stroke limit 2 (option 26) Stored stroke limit 3 (option 26) (Only for T series) Overtravel alarms (ALM 500 and 501) based on stored stroke limit 1 are automatically released by movement back along the axis to a point that does not exceed the limit.
External key input	External key input
External message/ External data input	External alarm message (option 27, 28) External operator message (option 27, 28) External program number search (option 28) External workpiece coordinate system shift (option 28) External machine coordinate system shift (option 28)
PMC axis control	4 path control (option 29)
Position switch	Position switch function (option 30)
Multiple path waiting function M code function (Only for T series)	By specifying an M code from the NC and loader, a wait operation can be performed.
Abnormal load detection	Abnormal load detection function (option 31)
External deceleration	External deceleration (option 32) ... For Series 16*i*/18*i*

NOTE

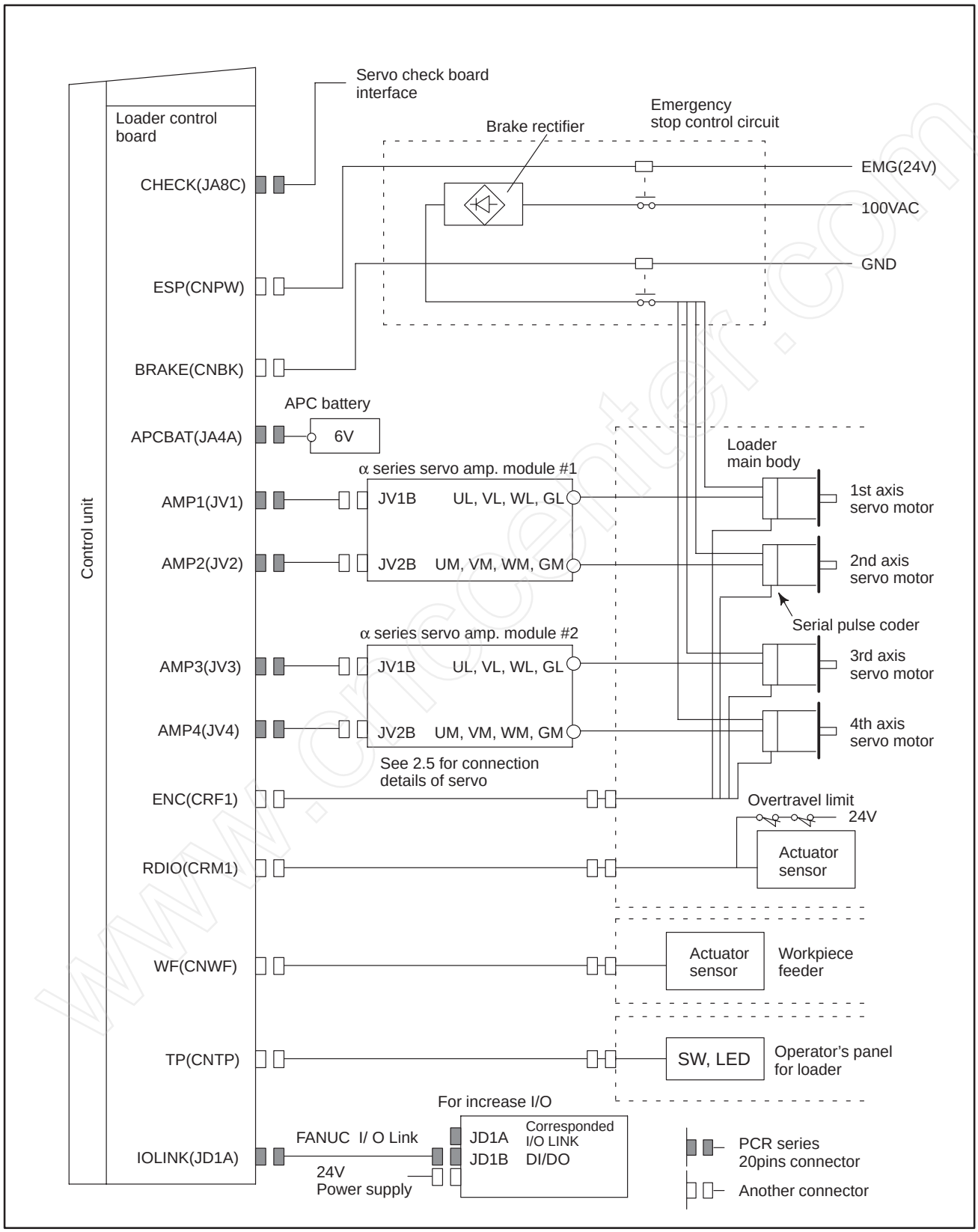
To use those functions for which option numbers are indicated, the following options are required.

Option 1 Part program storage length 20m
Option 2 Part program storage length 40m
Option 3 Part program storage length 80m
Option 4 PMC Ladder 3000 step
Option 5 PMC Ladder 4500 step (For Series 16/18–MODEL A)
PMC Ladder 5000 step (For Series 16/18–MODEL B/C, Series 21–TB, Series 16*i*/18*i*/21*i*)
Option 6 Reader Puncher control 1
Option 7 Directory display of floppy cassette
Option 8 Manual handle 1 unit control
Option 9 Manual handle 2 or 3 units control
(The use of the second and third units requires option 8 for the first unit.)
Option 10 Inch/metric conversion
Option 11 2nd feedrate override
(The Series 21, Series 21*i* does not support the 2nd feedrate override option.)
Option 12 Rapid traverse bell–shaped acceleration/deceleration
Option 13 Cutting feed linear acceleration/deceleration after interpolation
(For Series 16*i*/18*i*)
Option 14 3rd/4th reference position return
Option 15 Workpiece coordinate system
Option 16 Addition of optional block skip
Option 17 Stored pitch error compensation
Option 18 Programmable data input
Option 19 Macro executer
Option 20 Custom macro B
Option 21 Addition of custom macro common variables
Option 22 Interruption type custom macro
Option 23 Playback
Option 24 Extended part program editing
Option 25 Japanese display
Option 26 Extended stored stroke check
Option 27 External message
Option 28 External data input
(When the external data input option is selected, the external message option is not required.)
Option 29 PMC axis control by PMC
Option 30 Position switch function
Option 31 Abnormal load detection function
Option 32 External deceleration (For Series 16*i*/18*i*)

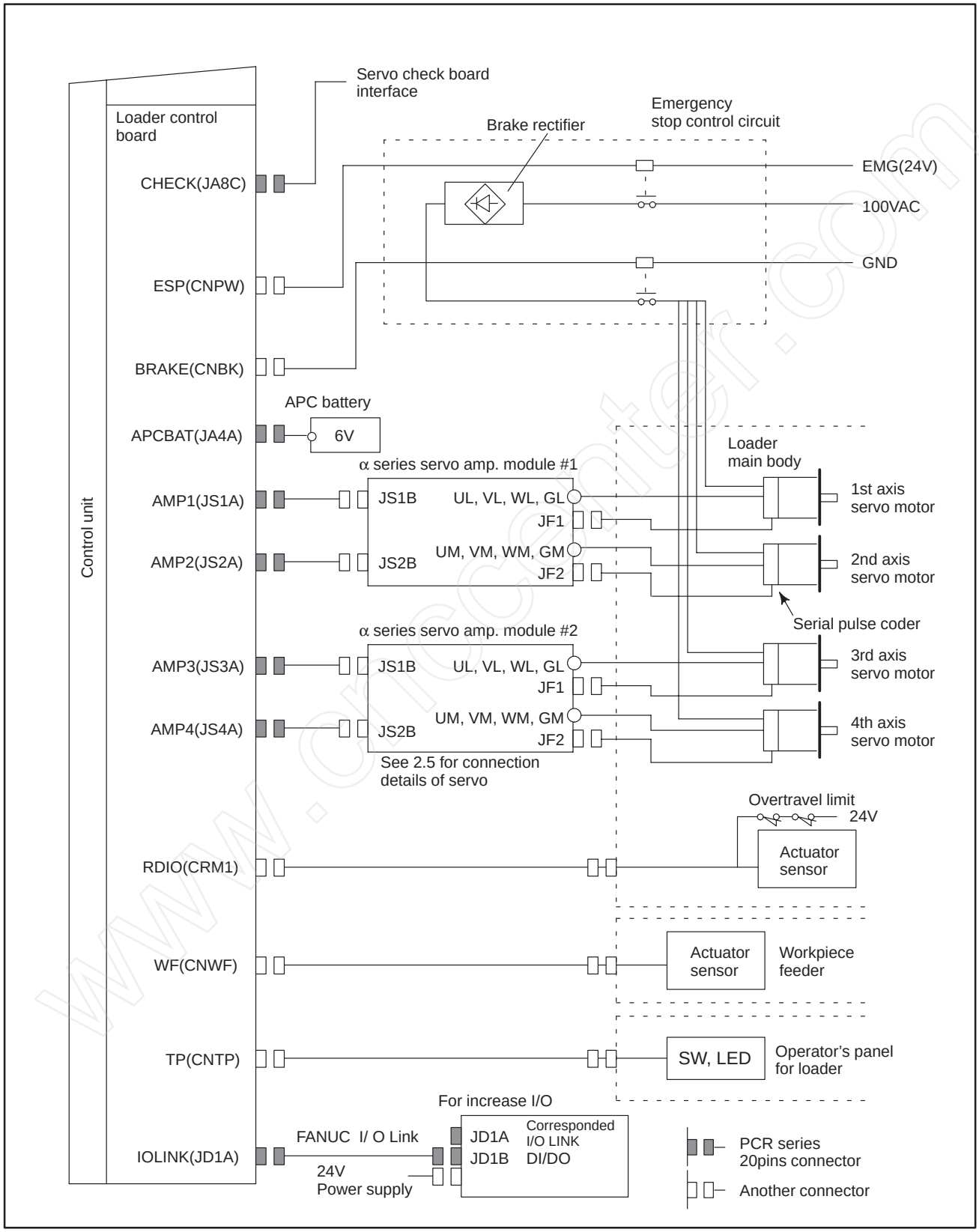
2 CONNECTION

2.1 TOTAL CONNECTION

When the Series 16/18–MODEL A loader control board, or the Series 16/18–MODEL B loader control board based on the main A specification is used:



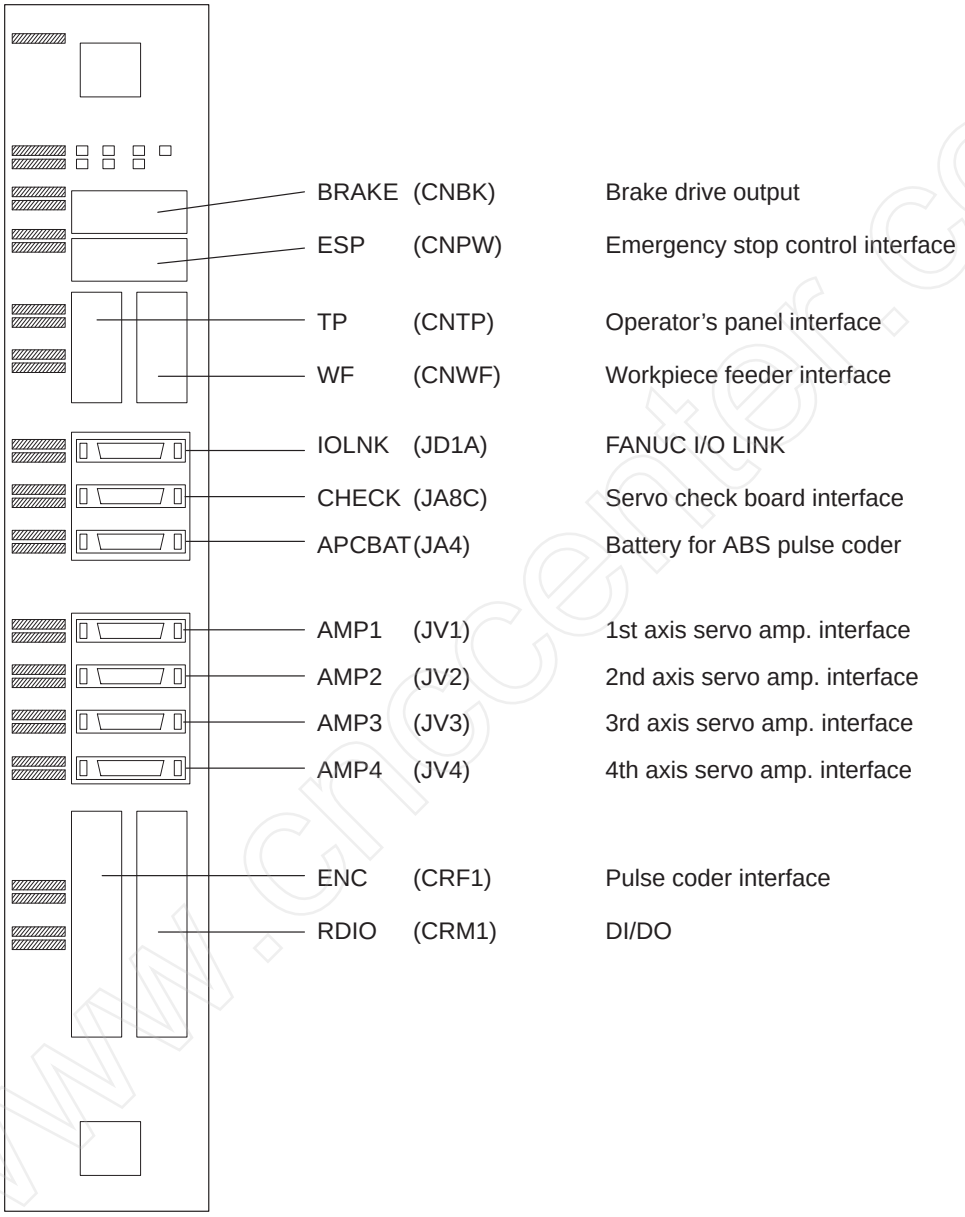
When the Series 16/18 loader control board based on the main B specification, Series 16/18–MODEL C or Series 21 loader control board is used



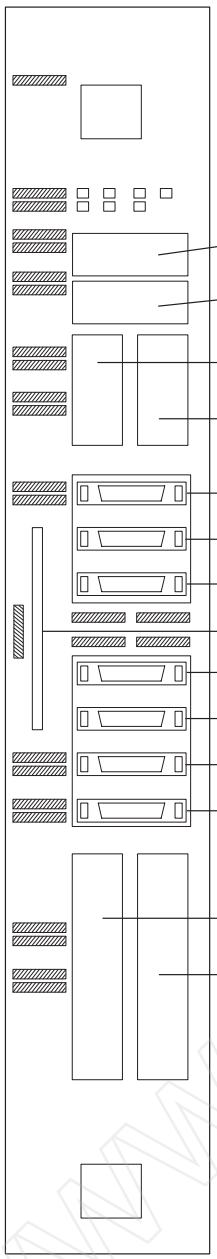
2.2 LOADER CONTROL BOADER

In common with the other control PC boards of the Series 16/18, the loader control board is mounted in the control unit. One slot is used exclusively for the loader control board. Any slot other than slot 1 can be used.

Layout of Series 16/18–MODEL A loader control board

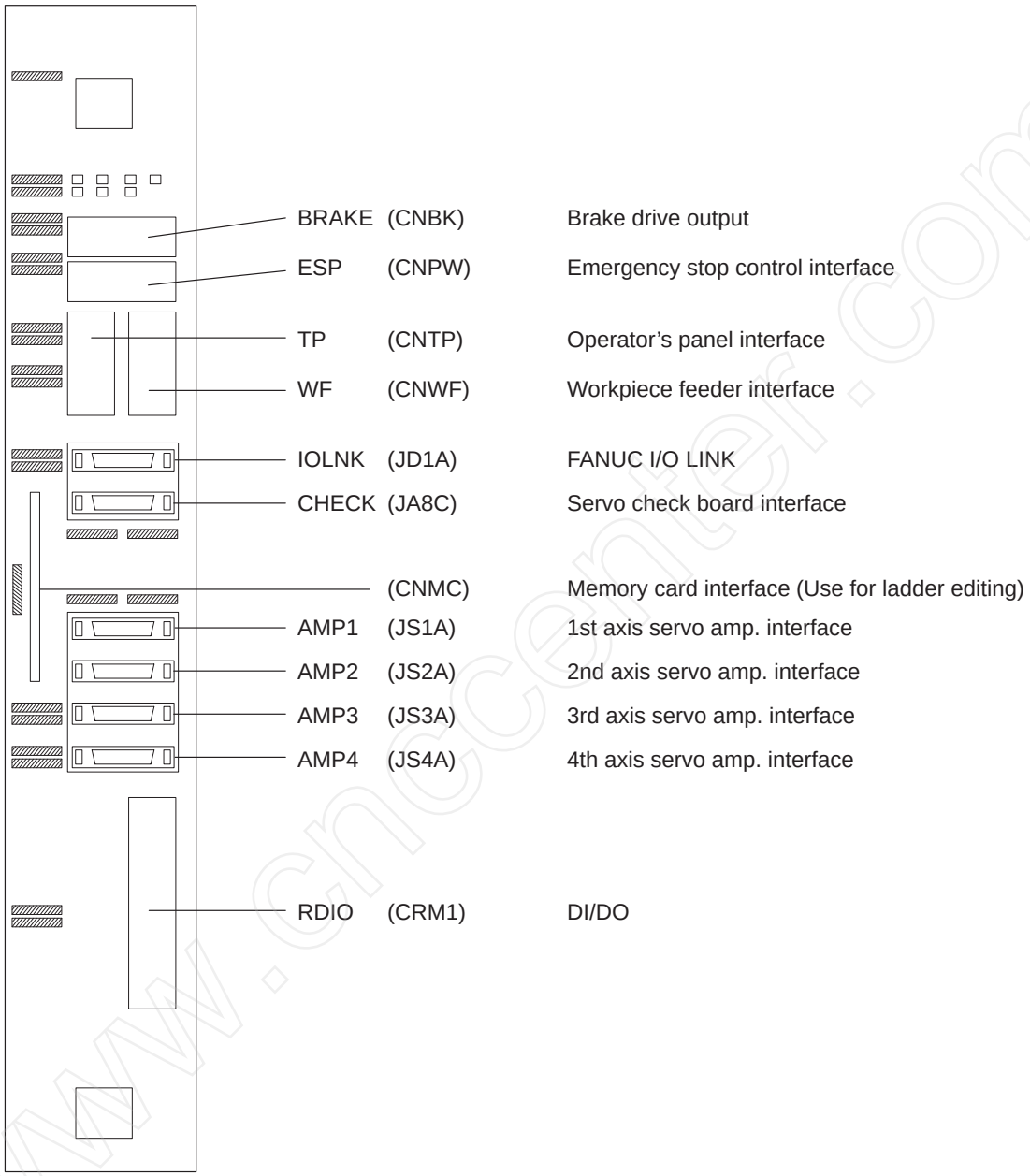


Panel layout of the Series 16/18–MODEL B loader control board based on the main A specification



BRAKE	(CNBK)	Brake drive output
ESP	(CNPW)	Emergency stop control interface
TP	(CNTP)	Operator’s panel interface
WF	(CNWF)	Workpiece feeder interface
IOLNK	(JD1A)	FANUC I/O LINK
CHECK	(JA8C)	Servo check board interface
APCBAT	(JA4)	Battery for ABS pulse coder
	(CNMC)	Memory card interface (Use for ladder editing)
AMP1	(JV1)	1st axis servo amp. interface
AMP2	(JV2)	2nd axis servo amp. interface
AMP3	(JV3)	3rd axis servo amp. interface
AMP4	(JV4)	4th axis servo amp. interface
ENC	(CRF1)	Pulse coder interface
RDIO	(CRM1)	DI/DO

Panel layout of the Series 16/18–MODEL B loader control board based on the main B specification, Series 16/18–MODEL C loader control board, or Series 21 loader control board



2.3 CONNECTING THE LOADER OPERATOR'S PANEL

The loader operator's panel is used to jog the loader and perform teaching. For the loader operator's panel, the I/O signals described below are stored on the loader control board.

2.3.1 Outline

DI = 8 points (+24 V contact signal input)
DO = 6 points (LED drive sink output)
DO = 4 points (common voltage drive source output)
DI = 1 point (+24 V contact signal input, emergency stop input signal)

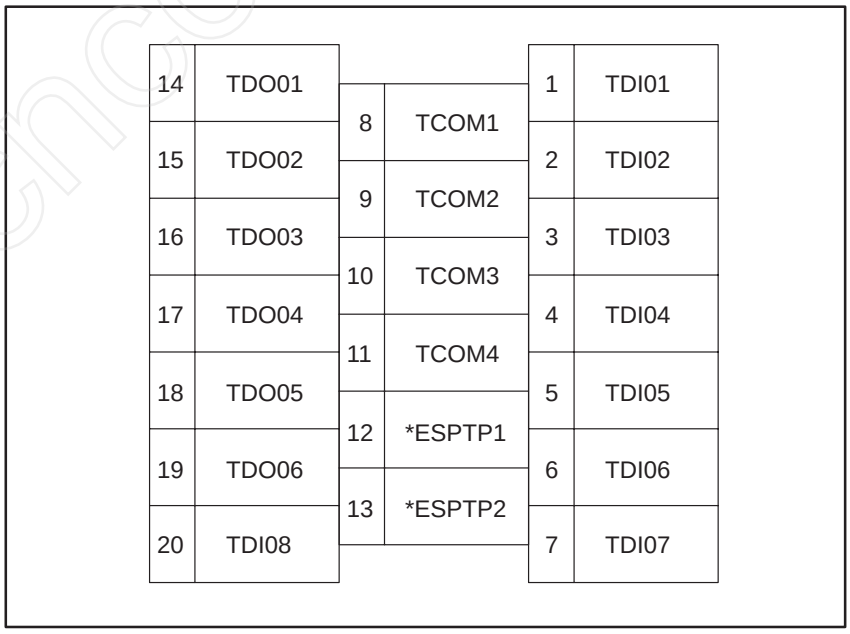
These I/O signals are used for loader operator's panel switch input and driving LED indicators.

The common voltage drive source output is provided to interface with switches and LEDs connected in matrix format. The use of a matrix format enables the number of input and output points to be increased to 32 and 24, respectively. In this case, the system software supports control of the common voltage drive source output for matrix scanning, so that no PMC program is required. Bit 1 of parameter No. 7902 is used to specify whether to use a matrix connection.

2.3.2 Connector

CNTP (MR20–pin, male)

Connector pin layout on the loader control board



2.3.3 Signals

Operator’s panel input signals TDI01 to TDI08

[Classification] Contact signal input, tied to common 24 V

[Function] These signals, used with common voltage drive source output signals TCOM1 to TCOM4, are used to scan a key matrix. In this case, key scanning for up to 32 (8 x 4) keys can be performed. When no matrix is used, TDI01 to TDI08 can be used as individual DI signals.

Operator’s panel output signals TDO01 to TDO06

[Classification] Transistor sink output, 24 V/200 mA load

[Function] These signals, used with common voltage drive source output signals TCOM1 to TCOM4, are used to scan an LED matrix. In this case, dynamic on/off control can be applied to up to 24 (6 x 4) LEDs at 16–msec intervals with a duty cycle of 4:1. See Section 2.4 for details of the required connection. When no matrix is used, TDO01 to TDO06 can be used as individual DO signals.

Common voltage drive output signals TCOM1 to TCOM4

[Classification] Transistor source output, 24 V/200 mA load

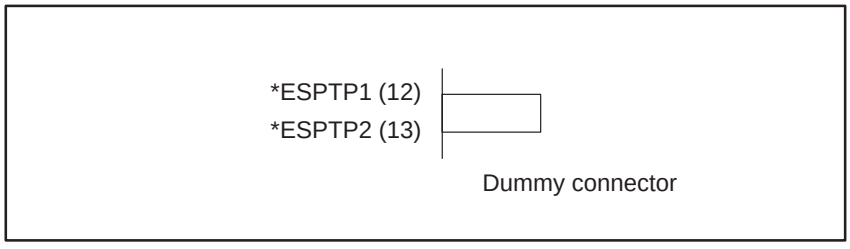
[Function] These signals are used to drive the common voltage signals when a matrix is created. When these signals are set to 1 by the PMC, 24 V is output to the signal pin. This signal can drive up to 8 contact signal inputs and up to 6 LEDs. The total load current, however, must not exceed 200 mA. To drive the contact signal inputs, 8 mA/point is required. This means that up to 22 mA can be drawn by each LED. When a matrix is not used, TCOM1 to TCOM4 can be used as individual DO (source output) signals.

Emergency stop input signals *ESPTP1, *ESPTP2

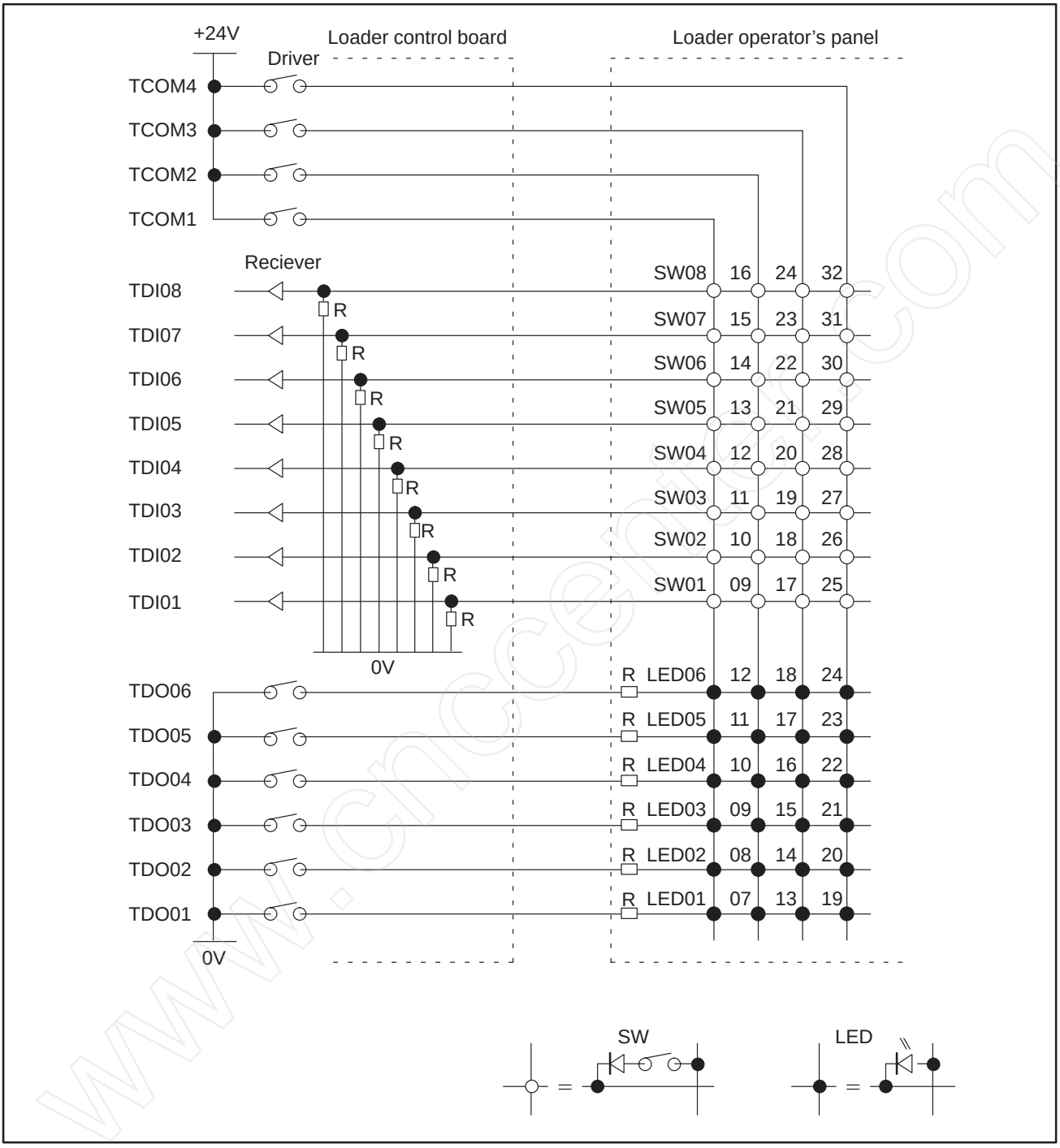
[Classification] Contact signal input used for emergency stop

[Function] The contact signal from the emergency stop button on the operator’s panel is connected in series with *LOT within the board to drive the externally mounted emergency stop relay. See Section 2.5 for details of this connection. Connect contact B of the emergency stop button on the loader operator’s panel to *ESPTP1 and *ESPTP2.

If this connection is broken, the loader performs an emergency stop. When this connector is not used, install a dummy connector to enable signal processing, as shown below.



2.3.4
Matrix Configuration



2.4 I/O SIGNAL CONNECTION FOR MAIN LOADER UNIT CONTROL

I/O signals used for controlling the main loader unit are stored in the loader control board.

2.4.1 Outline

DI = 6 points (contact signal input, general purpose)
DO = 8 points (sink output, general purpose)
DI = 1 point (+24 V contact signal input, emergency stop input signal)

For operations such as opening/closing the hand on the tip of the loader and air blow control, 6 DI points and 8 DO points are provided. The emergency stop input signal stops the loader immediately in situations such as loader overtravel (detected by hardware) or hand destruction.

2.4.2 Connector

CRM1 (MR50–pin, female)

Connector pin layout on the loader control board

1	LDI01			33	LDO01
2	LDI02			34	LDO02
3	LDI03	19	*LOT	35	LDO03
4	LDI04	20	LDI06	36	LDO04
5		21	LDI05	37	LDO05
6		22	COMLD	38	LDO06
7		23	COMWF	39	LDO07
8		24		40	LDO08
9	FDI01	25		41	FDO01
10	FDI02	26		42	FDO02
11	FDI03	27	0V	43	FDO03
12	FDI04	28	0V	44	FDO04
13	FDI05	29	0V	45	FDO05
14	FDI06	30	0V	46	FDO06
15	FDI07	31	+24E	47	FDO07
16	FDI08	32	+24E	48	FDO08
17	0V			49	+24E
18	0V			50	+24E

2.4.3 Signals

General–purpose input signals LDI01 to LDI06

[Classification] Contact signal input

LDI01 to LDI04 can be switched between 24 V common voltage and 0 V common voltage. LDI05 and LDI06 are tied to 24 V common voltage.

[Function] Six input signals are provided as interface signals. These can be used, for example, for checking whether the hand mounted on the tip of the loader is open or closed. These signals can be used for general purpose applications, depending on the function demanded of the mechanical unit of the loader. When an incremental pulse coder is used, and a reference position return operation is needed, LDI01 to LDI04 are used as deceleration signals *DEC1 to *DEC4.

These signals are directly referenced by the CNC that exercises loader control. When, however, skip operation is not required, the PMC can use these signals for general purpose applications.

General–purpose input signal common voltage selection COMLD

[Classification] Common voltage selection

[Function] When COMLD is connected to 0V, LDI01 to LDI04 function as 24 V common voltage input signals. When COMLD is connected to +24E, LDI01 to LDI04 function as 0 V common voltage input signals. Note that the signal polarity also changes accordingly. That is, when LDI01 to LDO04 are functioning as 24 V common voltage signals, logic 1 corresponds to the contact being closed; when LDI01 to LDO04 are functioning as 0 V common voltage signals, logic 0 corresponds to the contact being closed.

General–purpose output signals LDO01 to LDO08

[Classification] Transistor sink output, 24 V/200 mA load

[Function] For the control of operations such as opening/closing the hand mounted on the tip of the loader and air blow, 8 output signals are provided. These signals can be used for general purpose applications as required.

Loader overtravel signal *LOT

[Classification] Contact signal input used for emergency stop, tied to common 24 V

[Function] The emergency stop input signal stops the loader immediately in situations such as loader overtravel (detected by hardware) or hand destruction. B contact point input is assumed. So, ensure that 24 V is applied in the normal state. When this DI signal is read in the normal state, a value of 1 is read. When this signal is turned off (when the contact opens), this DI signal changes to 0, and the *EMG1 signal of the CNPW connector is turned off. Then, the externally mounted emergency stop control relay is turned off to shut down the MCC of the servo system. This shutdown state continues for as long as *LOT is off. To enable this state to be released temporarily, the OTR signal is provided. See Section 2.6 for further information.

General–purpose workpiece feeder input signals FDI01 to FDI08

[Classification] Contact signal input, switchable between common 24 V and 0 V

[Function] For workpiece feeder interfacing, 8 input signals are provided. These signals can also be used for general purpose applications, depending on the function demanded of the mechanical unit of the loader. However the skip function is used, FDI08 is used as skip signal. Skip operation is no required, FDI08 can be used for general applications. These signals are also applied to a separate connector, CNWF, connected in parallel.

General–purpose input signal common voltage selection for the workpiece feeder COMWF

[Classification] Common voltage selection

[Function] When COMWF is connected to 0V, FDI01 to FDI08 function as 24 V common voltage input signals. When COMWF is connected to +24E, FDI01 to FDI08 function as 0 V common voltage input signals. Note that the signal polarity also changes accordingly. That is, when FDI01 to FDI08 are functioning as 24 V common voltage signals, logic 1 corresponds to the contact being closed; when FDI01 to FDI08 are functioning as 0 V common voltage signals, logic 0 corresponds to the contact being closed. This signal is also applied to a separate connector, CNWF, connected in parallel.

General–purpose workpiece feeder output signals FDO01 to FDO08

[Classification] Transistor sink output, 24 V/200 mA load

[Function] For workpiece feeder interfacing, 8 output signals are provided. These signals can also be used for general purpose applications, depending on the function demanded of the mechanical unit of the loader. These signals are also applied to a separate connector, CNWF, connected in parallel.

2.5 SERVO SYSTEM CONNECTION

2.5.1 Outline

The tables below list the connectors used to connect the servo system.

When using the Series 16/18–MODEL A loader control board, or the Series 16/18–MODEL B loader control board based on the main A specification

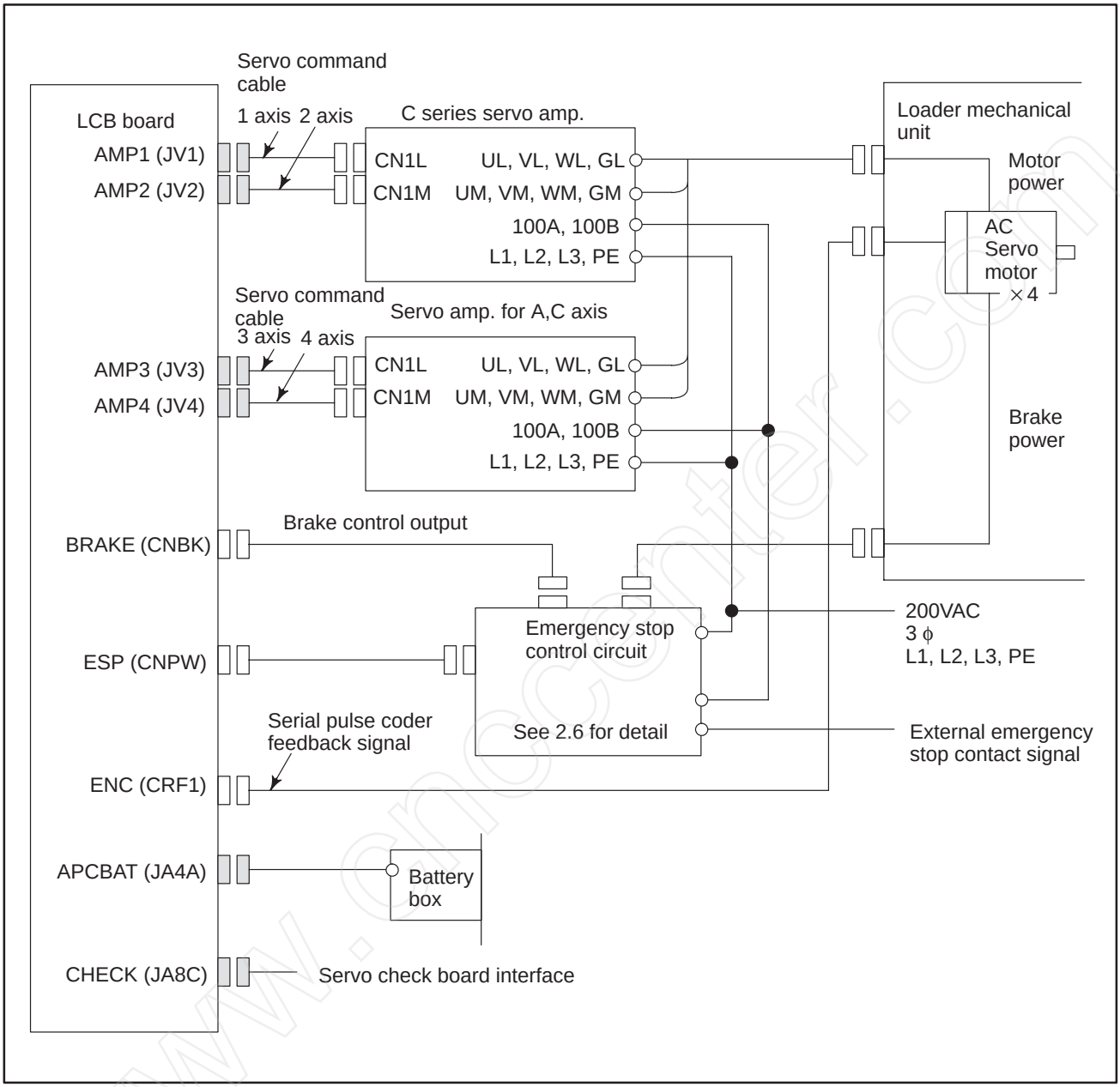
Controlled axis number	Connector		
	Servo command	Feedback signal	Brake control
1	JV1	CRF1 (common to 4 axes)	CNBK (common to 4 axes)
2	JV2		
3	JV3		
4	JV4		

When using the Series 16/18–MODEL B loader control board based on the main B specification, Series 16/18–MODEL C loader control board, or Series 21 loader control board

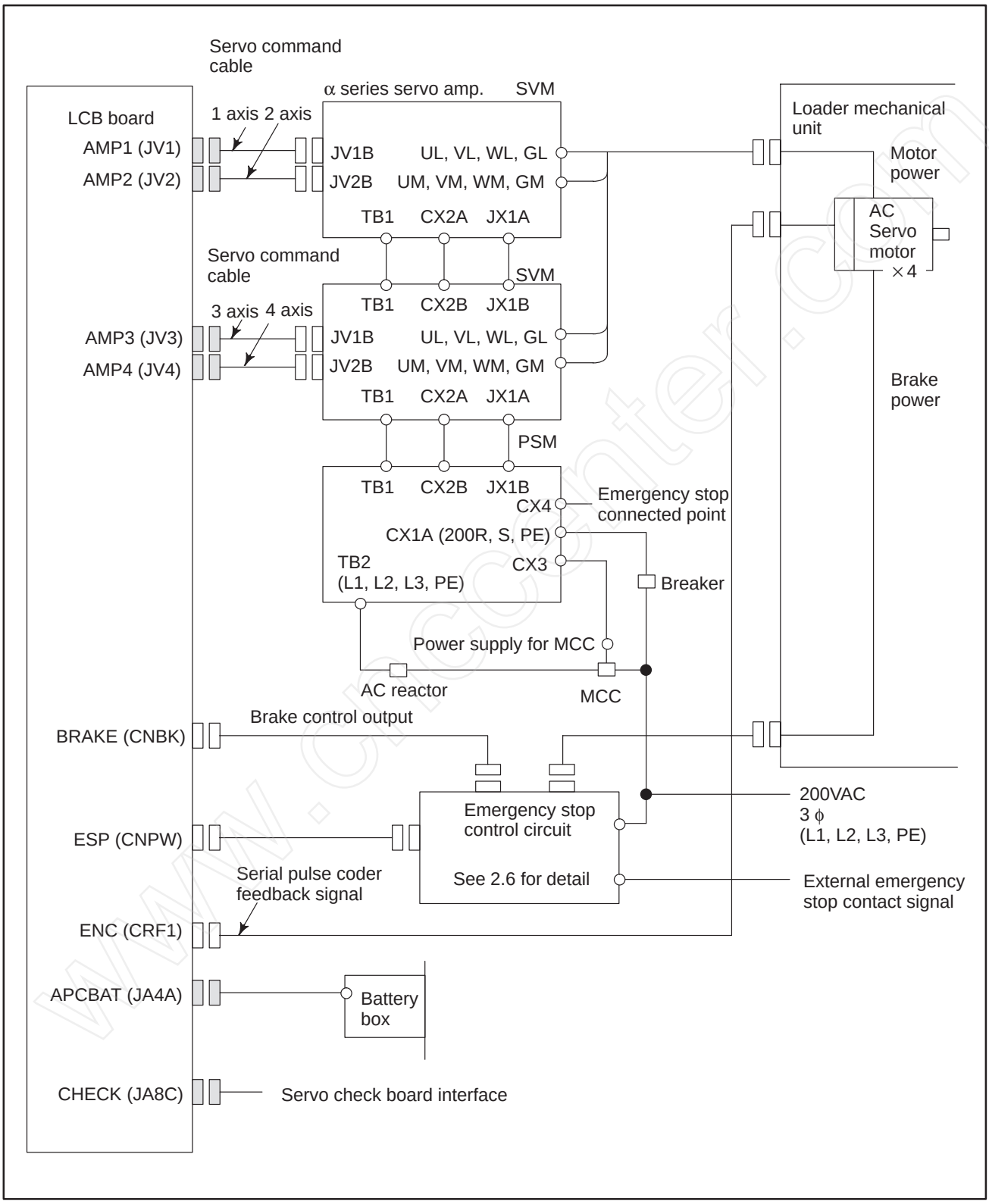
Controlled axis number	Connector		
	Servo command	Feedback signal	Brake control
1	JS1A	Connected to the servo amplifier module	CNBK (common to 4 axes)
2	JS2A		
3	JS3A		
4	JS4A		

2.5.2 Connection Diagram

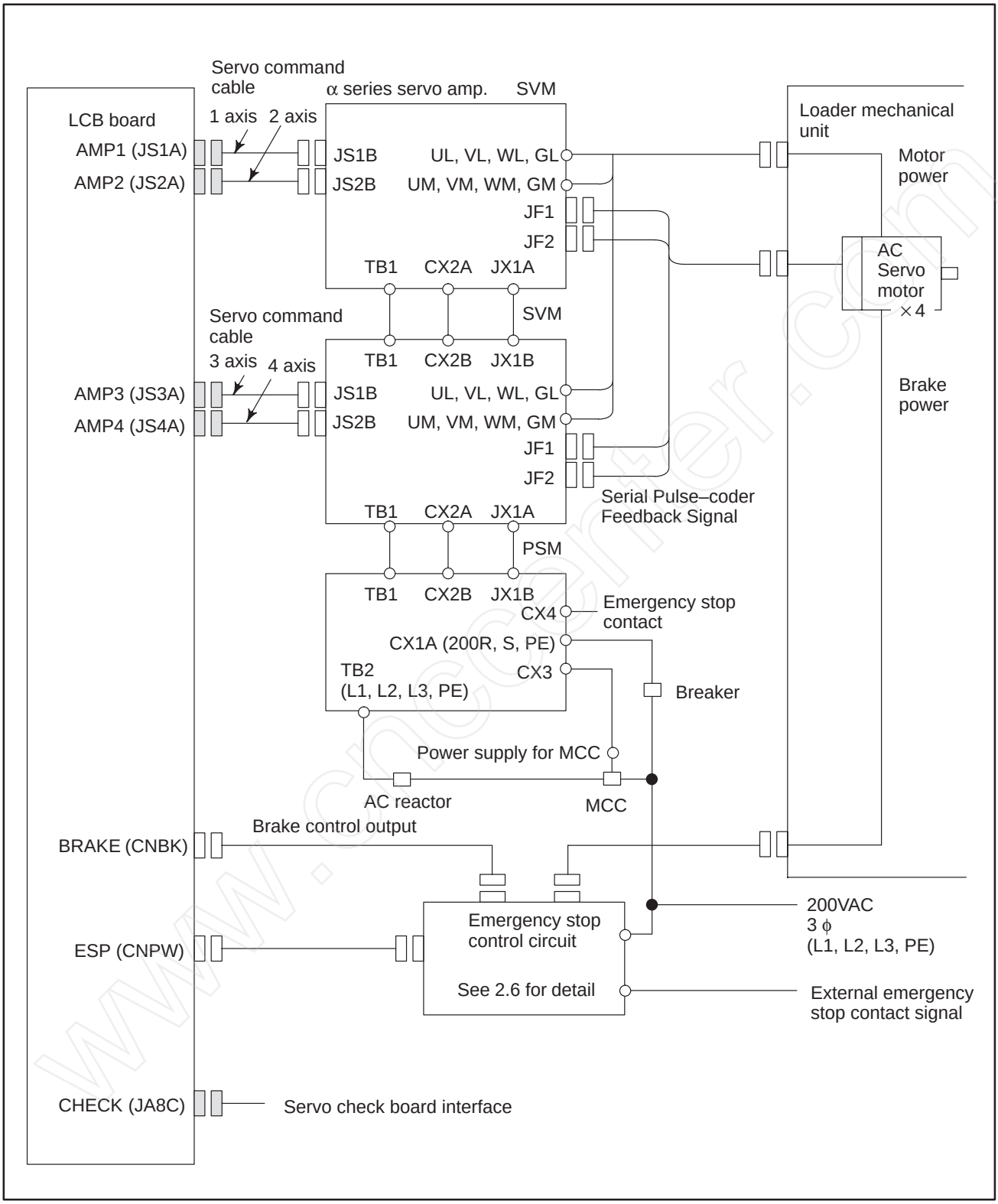
Servo system connection when using the C series servo amplifier



Servo system connection when using the α series servo amplifier (type A interface)



Servo system connection when using the α series servo amplifier (type B interface)



The connection of the Series 21 is shown only in the above figure.

2.5.3 Servo Amplifier Interface

Series 16/18–MODEL A loader control board, Series 16/18–MODEL B loader control board based on the main A specification

Loader control board

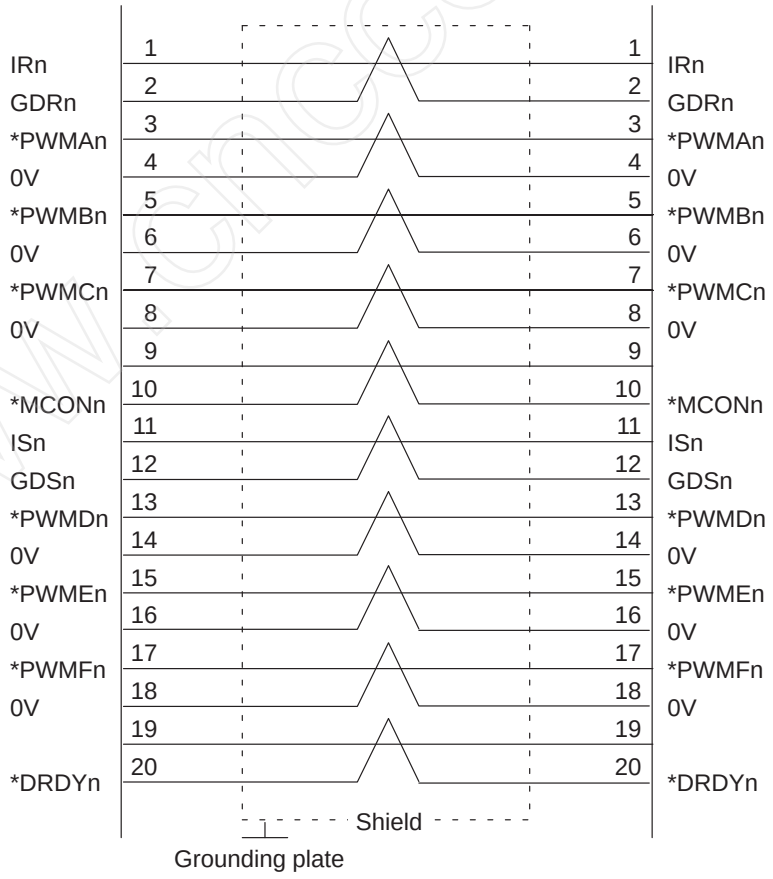
JV1 to JV4
(PCR–EV20MDT)

1	IRn	11	ISn
2	GDRn	12	GDSn
3	*PWMAn	13	*PWMDn
4	0v	14	0v
5	*PWMBn	15	*PWMEn
6	0V	16	0V
7	*PWMCn	17	*PWMFn
8	0V	18	0V
9		19	
10	*MCONn	20	*DRDYn

Servo amplifier

CN1, CN1L, CN1M (C Series)
JV1B, JV2B (α series typeB I/F)
(PCR–EV20MDT)

1	IRn	11	ISn
2	GDRn	12	GDSn
3	*PWMAn	13	*PWMDn
4	0V	14	0V
5	*PWMBn	15	*PWMEn
6	0V	16	0V
7	*PWMCn	17	*PWMFn
8	0V	18	0V
9		19	
10	*MCONn	20	*DRDYn



Series 16/18–MODEL B loader control board based on the main B specification, Series 16–MODEL C loader control board, or Series 21 loader control board

Loader control board

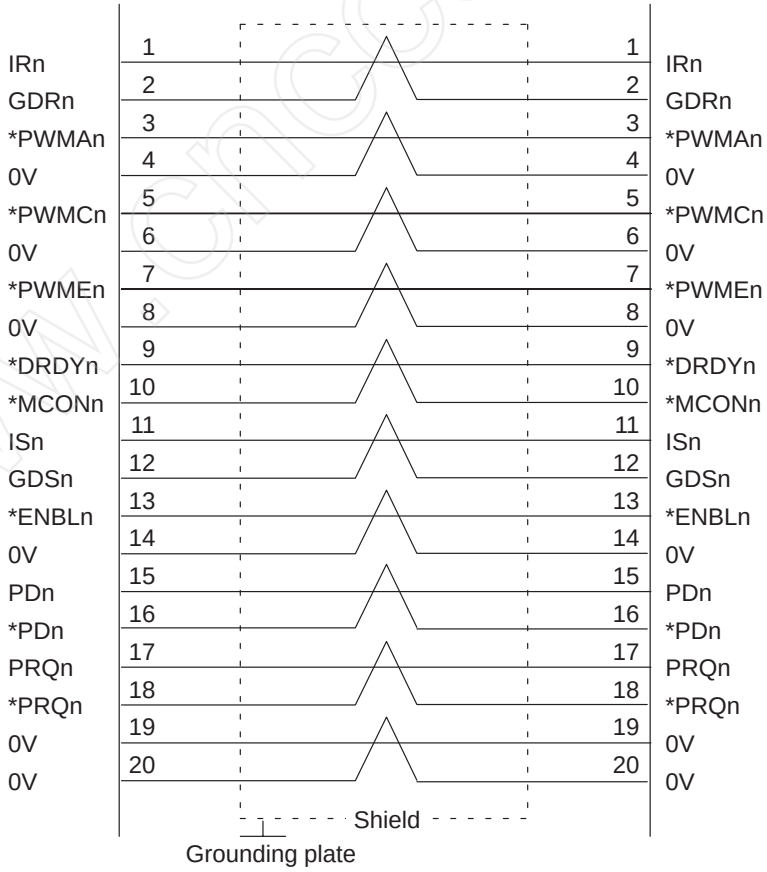
JS1A–JS4A
(PCR–EV20MDT)

1	IRn	11	ISn
2	GDRn	12	GDSn
3	*PWMAn	13	*ENBLn
4	0V	14	0V
5	*PWMCn	15	PD2
6	0V	16	*PD2
7	*PWMEn	17	PRQ2
8	0V	18	*PRQ2
9	*DRDYn	19	0V
10	*MCONn	20	0V

Servo amplifier

JS1B, JS2B (α series typeB I/F)
(PCR–EV20MDT)

1	IRn	11	ISn
2	GDRn	12	GDSn
3	*PWMAn	13	*ENBLn
4	0V	14	0V
5	*PWMCn	15	PD2
6	0V	16	*PD2
7	*PWMEn	17	PRQ2
8	0V	18	*PRQ2
9	*DRDYn	19	0V
10	*MCONn	20	0V

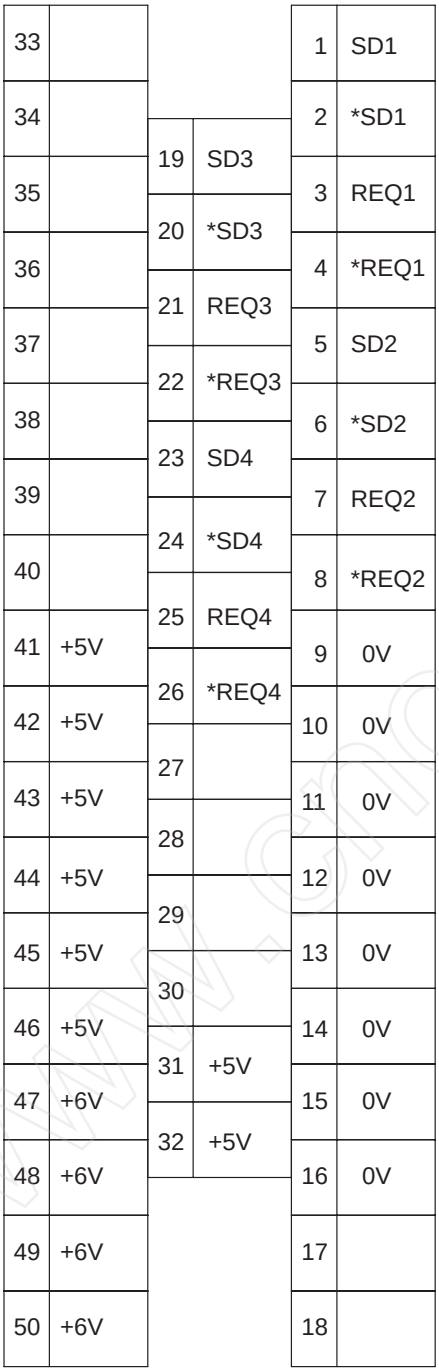


2.5.4 Pulse Coder Interface

Series 16/18–MODEL A loader control board, Series 16/18–MODEL B loader control board based on the main A specification

CRF1 (MR–50 male)

Location of connector pin in the side of loader control board



SDn
*SDn
REQn
*REQn
} Serial pulse coder signal (n : 1 to 4 control axes number)

0V Power supply for serial pulse coder
+5V Power supply for serial pulse coder

+6V Battery power supply for absolute serial pulse coder

2.5.5 Brake Drive Output Interface

CNBK (AMP D–3400, 12pins, male)

Location of connector pin in the side of loader control board

1D		2D		1D	
1C		2C		3C	
1B		2B		3B	
1A		2A		3A	BKOUT1+

BKOUT1+ Brake control output +side

2.5.6 Battery Interface for Absolute Pulse Coder

Series 16/18–MODEL A loader control board, Series 16/18–MODEL B loader control board based on the main A specification

JA4 (PCR–EV20MDT)

Location of connector pin in the side of loader control board

1		11	
2		12	
3	0V	13	
4		14	
5		15	
6		16	
7	+6V	17	
8		18	
9		19	
10		20	

+6V Battery power supply +side
0V Battery power supply –side

2.6 EMERGENCY STOP SYSTEM CONNECTION

2.6.1 Outline

The emergency stop control circuit has the functions listed below, and exercises control such that the servo drive power is turned off by hardware when an emergency stop is required.

1 Control of the servo amplifier MCC (electromagnetic contactor for turning on/off the motor power line)
2 Control of the brake mounted on each loader axis

These control functions are required to ensure safety. The machine usually supports similar functions. For the loader also, the machine tool builder may devise a proprietary circuit to provide the control functions explained above. An emergency stop control unit that can be used with the C series servo amplifier is available as an option from FANUC. A machine tool builder may, however, wish to incorporate the ememergency stop control circuit into the power magnetic circuit. In such a case, conform to the specifications given in this section.

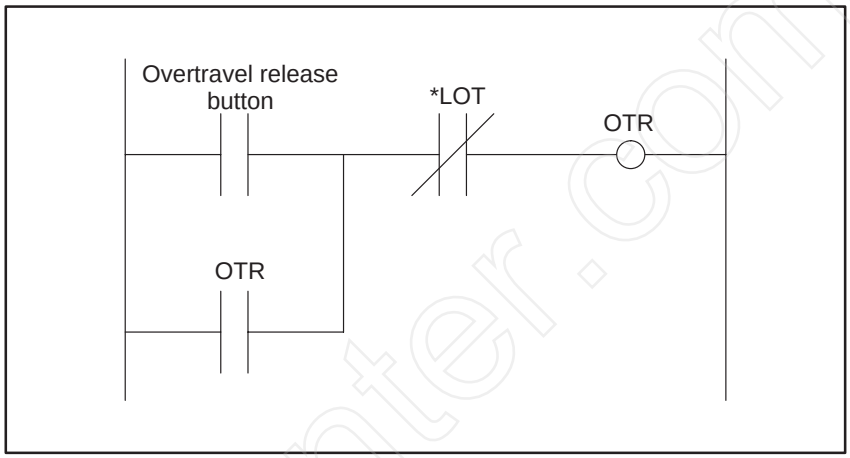
The interconnection diagram for an emergency stop system employing a C series servo amplifier is shown in Subsec. 2.6.2. The signal, *LOT, from the limit switch for detecting loader overtravel passes through the emergency stop button on the loader operator's panel, then drives relay RY1 in the emergency stop control unit. When external emergency stop conditions need to be set, a pin, provided before relay RY1, can be used to insert a contact in series. Jumper the pin when the pin is not required.

Normally, relay RY1 is on. When an emergency stop condition arises, relay RY1 is turned off, such that contact ry1 turns off the 100 VAC supply. This loss of the 100 VAC supply turns off the servo amplifier contactor (MCC), causing the servo drive power to be turned off by the hardware. At the same time, the 100 VDC supply is also turned off, turning off the power to, and thus actuating, the brake.

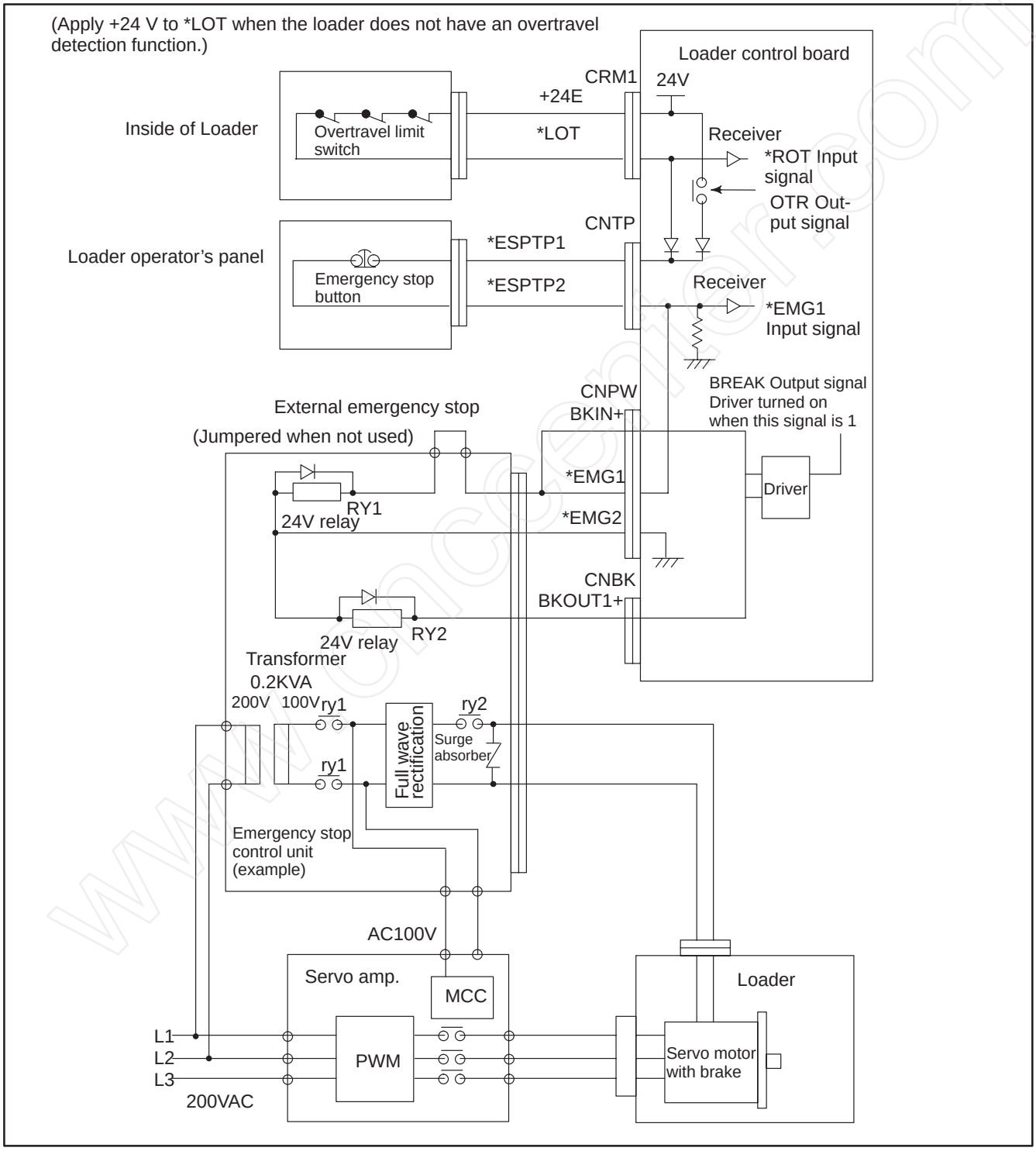
When an α series servo amplifier is being used, the same basic concept applies. Note, however, that an MCC for controlling the motor power line and a driving power supply must be installed external to the servo amplifier, and that an emergency stop contact must be connected to the power supply module.

Signals to the loader control PMC are transferred through the receiver circuit, as shown in the diagram. *LOT is the loader overtravel detection signal, and *EMG1 is the emergency stop signal from the loader operator's panel. Note that the circuit is configured such that when *LOT is turned on, *ESPTP is also turned on. Using a PMC ladder program, copy *EMG1 to emergency stop input G008.4 of the loader CNC.

If loader overtravel is detected, an emergency stop is performed as described above. The servo power is turned off, and the brake is actuated, thus preventing return from the overtravel. To overcome this, the overtravel release signal OTR can be used. When OTR is turned on, +24 V is forcibly applied to the *LOT line to release the emergency stop state. Jog the loader until *LOT is turned off. Note that the emergency stop button on the loader operator's panel is enabled even while this operation is being performed. OTR ignores *LOT. So, for safety, program the following logic with the PMC:



2.6.2 Emergency Stop System Connection (When a C Series Servo Amplifier is Used)



2.6.3 Emergency Stop Control Circuit Interface

CNPW (AMP D–3400, 12 pins, male)

Connector pin layout on loader control board

1D	*EMGHBK1	2D	*EMGHBK2	1D	HBKR
1C	*EMG1	2C	*EMG2	3C	
1B		2B		3B	
1A		2A		3A	BKIN+

*EMG1 Emergency stop control relay drive signal (+ side)
*EMG2 Emergency stop control relay drive signal (– side)

BKIN+ Brake control signal
*EMGHBK1
*EMGHBK2 } Not used
HBKR

2.7 WORKPIECE FEEDER CONNECTION

2.7.1 Outline

For workpiece feeder control, 8 input signals and 8 output signals are provided.

DI = 8 points (+24 V contact signal input, general purpose)

DO = 8 points (sink output, general purpose)

These signals are used to move the workpiece feeder back and forth.

2.7.2 Connector

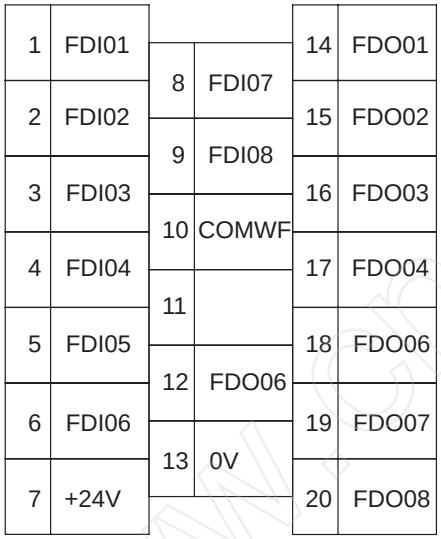
CNWF (MR20–pin, female)

CRM1 (MR50–pin, female)

The same signals are output on both connectors. The user can use whichever of the two connectors is most convenient.

CNWF (MR–20, female)

Connector pin layout on loader control board



FDI01–FDI08 : Input for workpiece feeder control
COMWF : Used for FDI01–08 common voltage switching
FDO01–FDO08 : Output for workpiece feeder control
+24V : Common voltage source
0V : Common voltage source

For information about CRM1, see Section 2.3.

2.7.3 Signals

General–purpose workpiece feeder input signals FDI01 to FDI08

[Classification] Contact signal input, switchable between common 24 V and 0 V

[Function] For workpiece feeder interfacing, 8 input signals are provided. These signals can also be used for general purpose applications depending on the function demanded of the mechanical unit of the loader. These signals are also applied to a separate connector, CNWF, connected in parallel.

General–purpose input signal common voltage selection for the workpiece feeder COMWF

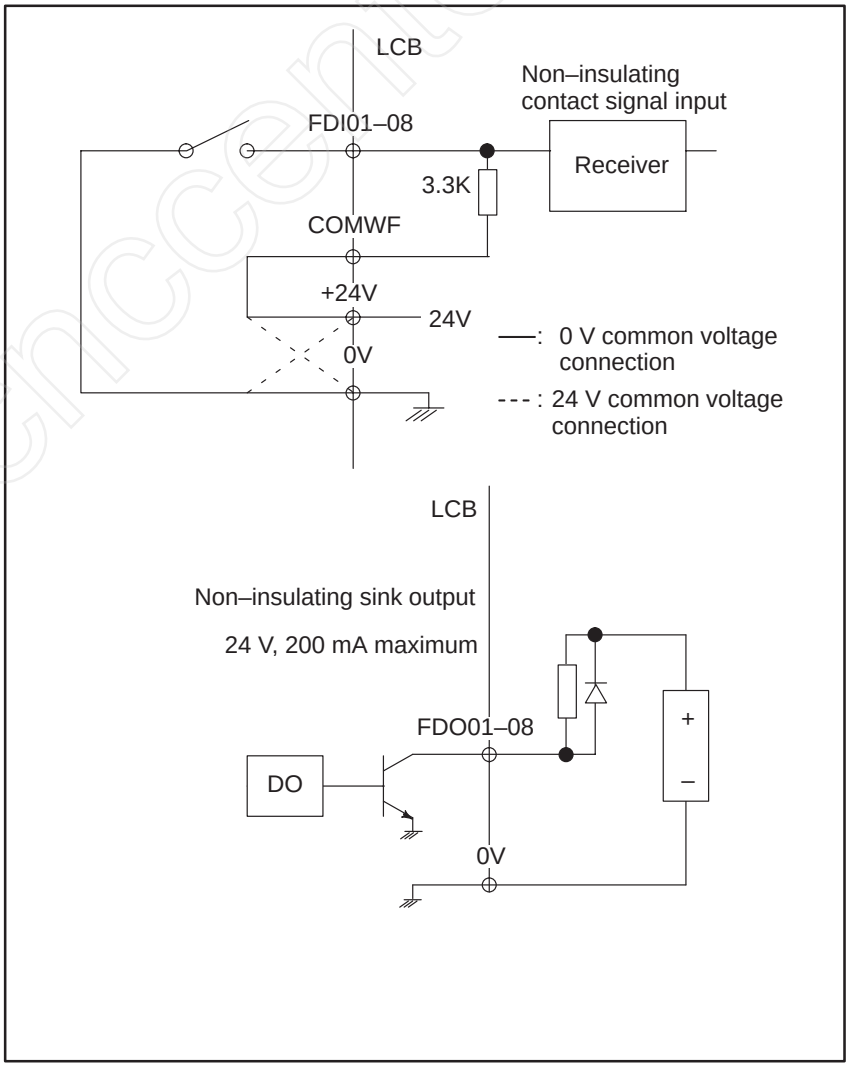
[Classification] Common voltage selection

[Function] When COMWF is connected to 0V, FDI01 to FDI08 function as 24 V common voltage input signals. When COMWF is connected to +24E, FDI01 to FDI08 function as 0 V common voltage input signals. Note that the signal polarity also changes accordingly. That is, when FDI01 to FDI08 are functioning as 24 V common voltage signals, logic 1 corresponds to the contact being closed; when FDI01 to FDI08 are functioning as 0 V common voltage signals, logic 0 corresponds to the contact being closed. This signal is also applied to a separate connector, CNWF, connected in parallel.

General–purpose workpiece feeder output signals FDO01 to FDO08

[Classification] Transistor sink output, 24 V/200 mA load

[Function] For workpiece feeder interfacing, 8 output signals are provided. These signals can also be used for general purposes, depending on the function demanded of the mechanical unit of the loader. These signals are also applied to a separate connector, CNWF, connected in parallel.



2.8 DI/DO INTERFACE

2.8.1 Outline

A PMC for loader control is built into the loader control board. The PMC has functions equivalent to PMC–RA1 of the Series 18/21. The development environment used with the PMC–RA1 is used. The I/O signals handled by the PMC are classified into three groups.

1 Loader control board built–in I/O signals

2 Signals for interfacing with the machine PMC

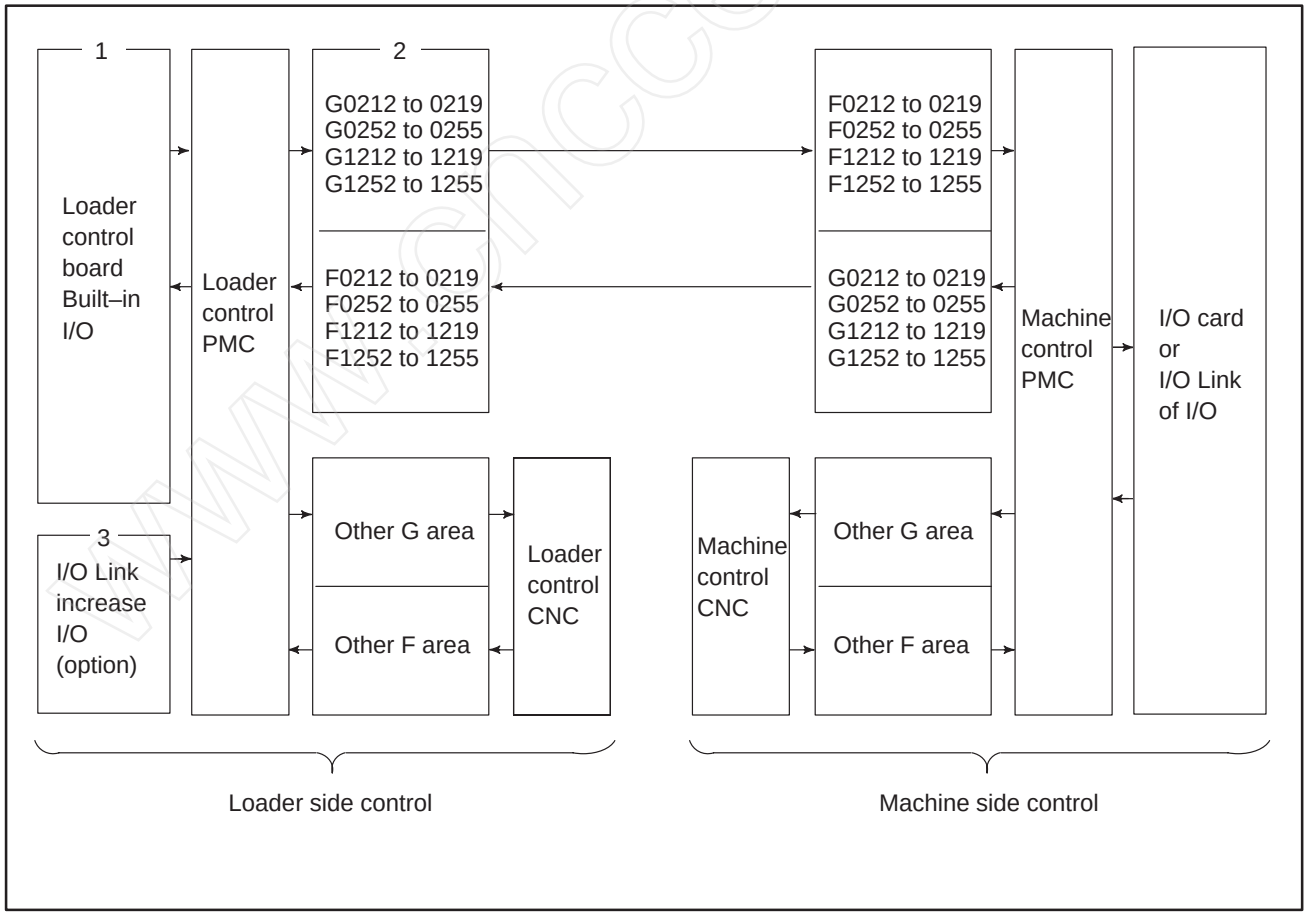
3 I/O signals connected, through an I/O link, to the loader control board

The signals of 1 are stored in the X/Y area, which is directly accessed by the PMC.

The signals of 2 are periodically transferred by system software from within the G/F area of the machine PMC to the G/F area of the loader PMC, or vice versa.

The signals of 3 are used as additional I/O signals, transferred using the FANUC I/O link when the signals of 1 alone are insufficient to configure a system.

The figure below illustrates the relationships between these I/O signals and PMCs. As shown below, the loader control PMC and machine control PMC operate independently of each other. In addition, the PMCs share signals for synchronous operation.



2.8.2 Loader Control Board Built–in I/O Signal

The table below lists the I/O signals stored in the loader control board.

Input signals (loader → loader control PMC)

Address	Symbol	Signal name
X1000.0	LDI01	Signals used for controlling the main loader unit: LDI01=*DEC1, LDI02=*DEC2, LDI03=*DEC3, LDI04=*DEC4. When a reference position return operation is performed, LDI01 to LDI04 function as *DEC1 to *DEC4, respectively.
X1000.1	LDI02	
X1000.2	LDI03	
X1000.3	LDI04	
X1000.4	LDI05	
X1000.5	LDI06	
X1000.6	*LOT	Loader overtravel signal
X1000.7	*EMG1	Emergency stop signal on the loader operator’s panel (affected by *LOT)
X1002.0	FDI01	Workpiece feeder control signals
X1002.1	FDI02	
X1002.2	FDI03	
X1002.3	FDI04	
X1002.4	FDI05	
X1002.5	FDI06	
X1002.6	FDI07	
X1002.7	FDI08	FDI08 is used as skip signal while skip function is used
X1004.0	TDI01	Loader operator’s panel input signals (These eight signals are used as general–purpose DI signals or matrix switch input signals.) (When these signals are used as matrix switch input signals, the PMC reads the switch states by using area X1010 to X1013, instead of directly referencing TDO01 to TDO08.)
X1004.1	TDI02	
X1004.2	TDI03	
X1004.3	TDI04	
X1004.4	TDI05	
X1004.5	TDI06	
X1004.6	TDI07	
X1004.7	TDI08	
X1010.0	SW01	Loader operator’s panel input signals (When these signals are used as matrix switch input signals, the state signals of the loader operator’s panel switches are expanded in this area.)
X1010.1	SW02	
X1010.2	SW03	
:	:	
:	:	
:	:	
:	:	
X1013.5	SW30	
X1013.6	SW31	
X1013.7	SW32	

Output signals (loader control PMC → loader)

Address	Symbol	Signal name
Y1000.0	LDO01	Signals used for controlling the main loader unit
Y1000.1	LDO02	
Y1000.2	LDO03	
Y1000.3	LDO04	
Y1000.4	LDO05	
Y1000.5	LDO06	
Y1000.6	LDO07	
Y1000.7	LDO08	
Y1001.0	FDO01	Workpiece feeder control signals
Y1001.1	FDO02	
Y1001.2	FDO03	
Y1001.3	FDO04	
Y1001.4	FDO05	
Y1001.5	FDO06	
Y1001.6	FDO07	
Y1001.7	FDO08	
Y1002.0	TCOM1	Loader operator’s panel common voltage control output signals (These four signals are used as general–purpose DO signals or matrix drive common voltage signals.)
Y1002.1	TCOM2	
Y1002.2	TCOM3	
Y1002.3	TCOM4	
Y1003.0	TDO01	Loader operator’s panel output signals (These six signals are used as general–purpose DO signals or matrix LED output signals. When these signals are used as matrix LED output signals, the PMC writes LED on/off data to area Y1010 to Y1013, instead of directly controlling TDO01 to TDO06.)
Y1003.1	TDO02	
Y1003.2	TDO03	
Y1003.3	TDO04	
Y1003.4	TDO05	
Y1003.5	TDO06	
Y1003.6		
Y1003.7	OTR	Loader overtravel release signal (1: Disables *LOT.)
Y1004.0	BRAKE	Brake control signal (0: Actuates the brake. 1: Releases the brake.)

Address	Symbol	Signal name
Y1010.0	LED01	Loader operator's panel matrix LED drive signals (1: Turns on an LED.)
Y1010.1	LED02	
Y1010.2	LED03	
Y1010.3	LED04	
Y1010.4	LED05	
Y1010.5	LED06	
Y1011.0	LED07	
Y1011.1	LED08	
Y1011.2	LED09	
Y1011.3	LED10	
Y1011.4	LED11	
Y1011.5	LED12	
Y1012.0	LED13	
Y1012.1	LED14	
Y1012.2	LED15	
Y1012.3	LED16	
Y1012.4	LED17	
Y1012.5	LED18	
Y1013.0	LED19	
Y1013.1	LED20	
Y1013.2	LED21	
Y1013.3	LED22	
Y1013.4	LED23	
Y1013.5	LED24	

2.8.3 Signals for Interfacing with the Loader Control CNC

The interface signals used between the CNC, built into the loader control board, and the loader control PMC conform to the specifications for the ordinary Series 16/18/21 PMC interface signals. This means that, for the loader PMC, ladder programs can be developed using the same interface as that for the machine PMC. Note, however, that not all signals can actually be used for loader control. For details, see Subsec. 2.8.4.

For details of each function, refer to the following manuals:

- FANUC Series 16/18 Connection Manual (B–61803E)
- FANUC Series 16/18/160/180–MODEL B Connection Manual (Function) (B–62443E–1)
- FANUC Series 16/18/160/180–MODEL C Connection Manual (Function) (B–62753EN–1)
- FANUC Series 21/210 Connection Manual (Function) (B–62703EN)

2.8.4 DI/DO Signals (Function by Function)

Ready	NC ready signal	MA (F001#7)
	Servo ready signal	SA (F000#6)
Emergency stop Reset	Emergency stop signal	*ESP (G008#4, X1000#7)
	External reset signal	ERS (G008#7)
	Reset & Rewind signal	RRW (G008#6)
	Resetting signal	RST (F001#1)
	Rewinding signal	RWD (F000#0)
Status signal	Alarm signal	AL (F001#0)
	Battery alarm signal	BAL (F001#2)
	Axis moving signal	MV1 – MV4 (F102#0 – #3)
	Axis moving direction signal	MVD1 – MVD4 (F106#0 – #3)
	In–position signal	INP1 – INP4 (F104#0 – #3)
	Rapid traverse signal	RPDO (F002#1)
	Inch input signal	INCH (F002#0)
	Cutting feed signal	CUT (F002#6)
Mode selection	Mode selection signal	MD1, MD2, MD4 (G043#0 – #2)
	Operation mode comfirmation signal	MMDI (F003#3)
		MMEM (F003#5)
		MEDT (F003#6)
		MH (F003#1)
		MINC (F003#0)
		MJ (F003#2)
		MREF (F004#5)
		MTCHIN (F003#7)
Manual feedrate override	Feed axis direction	+J1 – +J4 (G100#0 – #3)
		–J1 – –J4 (G102#0 – #3)
	Jog feedrate override signal	*JVO – *JV15 (G010 – G011)
	Manual rapid traverse signal	RT (G019#7)
	Rapid traverse override signal	ROV1, ROV2 (G014#0, #1)
	1% rapid traverse override	HROV (G096#7)
	Select signal	
	1% rapid traverse override signal	*HROV0 – *HROV6 (G096#0 – #6)
	Manual absolute signal	*ABSM (G006#2)
	Manual absolute confirmation signal	MABSM (F004#2)
Interlock	Start lock signal	STLK (G007#1)
	Interlock signal for all axes	*IT (G008#0)
	Interlock signal for each axis	*IT1 – *IT4 (G130#0 – #3)

Manual handle feed incremental feed	Manual handle feed axis select signal	HS1A, HS1B, HS1C, HS1D (G018#0 – #3)
		HS2A, HS2B, HS2C, HS2D (G018#4 – #7)
	Incremental feed signal (Manual handle feed movement amount select signal)	MP1, MP2 (G019#4, #5)
Reference position return	Manual reference position return select signal	ZRN (G043#7)
	Deceleration signal for reference position return signal	*DEC1 – *DEC4 (X1000#0 – #3)
	Reference position return completion signal	ZP1 – ZP4 (F094#0 – #3)
	2nd reference position return completion signal	ZP21 – ZP24 (F096#0 – #3)
	3rd reference position return completion signal	ZP31 – ZP34 (F098#0 – #3)
	4th reference position return completion signal	ZP41 – ZP44 (F100#0 – #3)
	Reference position completion signal	ZRF1 – ZRF4 (F120#0 – #3)
Program protect key	Memory protect signal	KEY1 – KEY4 (G046#3 – #6)
Automatic operation	Cycle start signal	ST (G007#2)
	Feed hold signal	*SP (G008#5)
	Cycle start LED signal	STL (F000#5)
	Feed hold LED signal	SPL (F000#4)
	Automatic operating signal	OP (F000#7)
	Workpiece number search signal	PN1 – PN8 (G009#0 – #3)
	Machine lock signal for all axes	MLK (G044#1)
	Machine lock signal for each axis	MLK1 – MLK4 (G108#0 – #3)
	Machine lock confirmation signal for all axes	MMLK (F004#1)
	Single block signal	SBK (G046#1)
	Single block confirmation signal	MSBK (F004#3)
	Feedrate override signal	*FV0 – *FV7 (G012)
	2nd feedrate override signal	*AFV0 – *AFV7 (G013)
	Override cancel signal	OVC (G006#4)
	Optional block skip signal	BDT1 (G044#0)
		BDT2 – BDT9 (G045#0 – #7)
	Optional block skip confirmation signal	MBDT1 (F004#0)
		MBDT2 – MBDT9 (F005#0 – #7)
	Error detect signal	SMZ (G053#6)
Auxiliary function	Auxiliary function code signal	M00 – M31 (F010 – F013)
	Auxiliary function strobe signal	MF (F007#0)
	Finish signal	FIN (G004#3)
	Auxiliary function finish signal	MFIN (G005#0)
	Distribution end signal	DEN (F001#3)
	Auxiliary function lock signal	AFL (G005#6)
	Auxiliary function lock comfirmation signal	MAFL (F004#4)
Multiple M commands	2nd M function code signal	M200 – M215 (F014 – F015)
	2nd M function strobe signal	MF2 (F008#4)
	2nd M function finish signal	MFIN2 (G004#4)
	3rd M function code signal	M300 – M315 (F016 – F017)
	3rd M function strobe signal	MF3 (F008#5)
	3rd M function finish signal	MFIN3 (G004#5)

S function	S function code signal	S0 – S31 (F022 – F025)
	S function strobe signal	SF (F007#2)
	S function finish signal	SFIN (G005#2)
Skip function	Skip signal	SKIP (X1002#7)
Overtravel	Over travel signal	*+L1 – *+L4 (G114#0 – #3)
		*–L1 – *–L4 (G116#0 – #3)
	Stored stroke limit select signal	EXLM (G007#6)
	Loader overtravel signal	*LOT (X1000#6)
Mechanical handle feed	Servo off signal	SVF1 – SVF4 (G126#0 – #3)
	Follow–up signal	*FLWU (G007#5)
External data input	1) External alarm message function	
	2) External operation message function	
	3) External program number search function	
	Data signal	ED00 – ED15 (G000 – G001)
	Address signal	EA0 – EA6 (G002#0 – #6)
	Read signal	ESTB (G002#7)
	Read finish signal	EREND (F060#0)
	Search finish signal	ESEND (F060#1)
Custom macro	Input signal for custom macro	UI0 – UI15 (G054 – G055)
	Output signal for custom macro	UO0 – UO15 (F054 – F055)
		UO100 – UO131 (F056 – F059)
	Interrupt signal for custom macro	UINT (G053#3)
Position switch function	Position switch signal	PSW01 – PSW10 (F070#0 – F071#1)
Axis control function by PMC		
1) GroupA	Axis control command signal	EC0A – EC6A (G143#0 – #6)
	Axis control command read signal	EBUFA (G142#7)
	Axis control command read finish signal	EBSYA (F130#7)
	Reset signal	ECLRA (G142#6)
	Axis control temporary stop signal	ESTPA (G142#5)
	Servo off signal	ESOFA (G142#4)
	Block stop signal	ESBKA (G142#3)
	Block stop disable signal	EMSBKA (G143#7)
	Auxiliary function code signal	EM11A – EM28A (F132)
	Auxiliary function strobe signal	EMFA (F131#0)
	Auxiliary function completion signal	EFINA (G142#0)
	Axis control feedrate signal	EIF0A – EIF15A (G144 – G145)
	Axis control data signal	EID0A – EID31A (G146 – G149)
	In–position signal	EINPA (F130#0)
	Following zero checking signal	ECKZA (F130#1)
	Alarm signal	EIALA (F130#2)
	Axis moving signal	EGENA (F130#4)
	Auxiliary function executing signal	EDENA (F130#3)
	Negative–direction overtravel signal	EOTNA (F130#6)
	Positive–direction overtravel signal	EOTPA (F130#5)

2) GroupB	Axis control command signal	EC0B – EC6B (G155#0 – #6)
	Axis control command read signal	EBUFB (G154#7)
	Axis control command read finish signal	EBSYB (F133#7)
	Reset signal	ECLRB (G154#6)
	Axis control temporary stop signal	ESTPB (G154#5)
	Servo off signal	ESOFB (G154#4)
	Block stop signal	ESBKB (G154#3)
	Block stop disable signal	EMSBKB (G155#7)
	Auxiliary function code signal	EM11B – EM28B (F135)
	Auxiliary function strobe signal	EMFB (F134#0)
	Auxiliary function completion signal	EFINB (G154#0)
	Axis control feedrate signal	EIF0B – EIF15B (G156 – G157)
	Axis control data signal	EID0B – EID31B (G158 – G161)
	In–position signal	EINPB (F133#0)
	Following zero checking signal	ECKZB (F133#1)
	Alarm signal	EIALB (F133#2)
	Axis moving signal	EGENB (F133#4)
	Auxiliary function executing signal	EDENB (F133#3)
	Negative–direction overtravel signal	EOTNB (F133#6)
	Positive–direction overtravel signal	EOTPB (F133#5)
3) GroupC	Axis control command signal	EC0C – EC6C (G167#0 – #6)
	Axis control command read signal	EBUFC (G166#7)
	Axis control command read finish signal	EBSYC (F136#7)
	Reset signal	ECLRC (G166#6)
	Axis control temporary stop signal	ESTPC (G166#5)
	Servo off signal	ESOFC (G166#4)
	Block stop signal	ESBKC (G166#3)
	Block stop disable signal	EMSBKC (G167#7)
	Auxiliary function code signal	EM11C – EM28C (F138)
	Auxiliary function strobe signal	EMFC (F137#0)
	Auxiliary function completion signal	EFINC (G166#0)
	Axis control feedrate signal	EIF0C – EIF15C (G168 – G169)
	Axis control data signal	EID0C – EID31C (G170 – G173)
	In–position signal	EINPC (F136#0)
	Following zero checking signal	ECKZC (F136#1)
	Alarm signal	EIALC (F136#2)
	Axis moving signal	EGENC (F136#4)
	Auxiliary function executing signal	EDENC (F136#3)
	Negative–direction overtravel signal	EOTNC (F136#6)
	Positive–direction overtravel signal	EOTPC (F136#5)

4) GroupD	Axis control command signal	EC0D – EC6D (G179#0 – #6)
	Axis control command read signal	EBUFD (G178#7)
	Axis control command read finish signal	EBSYD (F139#7)
	Reset signal	ECLRD (G178#6)
	Axis control temporary stop signal	ESTPD(G178#5)
	Servo off signal	ESOFD (G178#4)
	Block stop signal	ESBKD (G178#3)
	Block stop disable signal	EMSBKD (G179#7)
	Auxiliary function code signal	EM11D – EM28D (F141)
	Auxiliary function strobe signal	EMFD (F140#0)
	Auxiliary function completion signal	EFIND (G178#0)
	Axis control feedrate signal	EIF0D – EIF15D (G180 – G181)
	Axis control data signal	EID0D – EID31D (G182 – G185)
	In–position signal	EINPD (F139#0)
	Following zero checking signal	ECKZD (F139#1)
	Alarm signal	EIALD (F139#2)
	Axis moving signal	EGEND (F139#4)
	Auxiliary function executing signal	EDEND (F139#3)
	Negative–direction overtravel signal	EOTND (F139#6)
	Positive–direction overtravel signal	EOTPD (F139#5)
5) Common	Control axis select signal	EAX1 – EAX4 (G136#0 – #3)
	Control axis selection status signal	*EAXSL (F129#7)
	Feedrate override signal	*FV0E – *FV7E (G151)
	Override cancellation signal	OVCE (G150#5)
	Rapid traverse override signal	ROVIE, ROV2E (G150#0, #1)
	Dry run signal	DRNE (G150#7)
	Manual rapid traverse select signal	RTE (G150#6)
External key input control		EKSET (G066#7)
		ENBKY (G066#1)
		EKC0–EKC7 (G098)
		INHKY (F053#0)
		PRGDPL (F053#1)
		EKENB (F053#7)
Communication signal between LCD and NC		(G0212 – G0219)
		(G0252 – G0255)
		(G1212 – G1219)
		(G1252 – G1255)
		(F0212 – F0219)
		(F0252 – F0255)
		(F1212 – F1219)
		(F1252 – F1255)
Multi–path waiting by M code	3–path waiting ignorance signal	NMWT (G063#7)
	Waiting signal	WATO (F063#6)

2.8.5 DI/DO Signals (In Order of Addresses)

Address table for Series 16/18/21 LCB

MT→PMC

Bit No

Address	#7	#6	#5	#4	#3	#2	#1	#0
X1000	*EMG1	*LOT	LDI06	LDI05	*DEC4	*DEC3	*DEC2	*DEC1
X1001								
X1002	FDI08	FDI07	FDI06	FDI05	FDI04	FDI03	FDI02	FDI01
X1003								
X1004	TDI08	TDI07	TDI06	TDI05	TDI04	TDI03	TDI02	TDI01
X1005								
X1010	SW08	SW07	SW06	SW05	SW04	SW03	SW02	SW01
X1011	SW16	SW15	SW14	SW13	SW12	SW11	SW10	SW09
X1012	SW24	SW23	SW22	SW21	SW20	SW19	SW18	SW17
X1013	SW32	SW31	SW30	SW29	SW28	SW27	SW26	SW25

PMC→MT

Bit No.

Address	#7	#6	#5	#4	#3	#2	#1	#0
Y1000	LDO08	LDO07	LDO06	LDO05	LDO04	LDO03	LDO02	LDO01
Y1001	FDO08	FDO07	FDO06	FDO05	FDO04	FDO03	FDO02	FDO01
Y1002					TCOM4	TCOM3	TCOM2	TCOM1
Y1003	OTR		TDO06	TDO05	TDO04	TDO03	TDO02	TDO01
Y1004								BRAKE
Y1005								
Y1010			LED06	LED05	LED04	LED03	LED02	LED01
Y1011			LED12	LED11	LED10	LED09	LED08	LED07
Y1012			LED18	LED17	LED16	LED15	LED14	LED13
Y1013			LED24	LED23	LED22	LED21	LED20	LED19

CAUTION

When bit 1 of parameter No. 7902 (for matrix expansion for the loader operator's panel) is set to 1, X1010 to X1013 and Y1010 to Y1013 are used. At this time, X1004, Y1002, Y1003 (excluding OTR) cannot be used. When bit 1 of parameter No. 7902 is set to 0, X1010 to X1013 and Y1010 to Y1013 cannot be used.

PMC→CNC

Address table for Series 16/18/21 LCB

Address	Bit No. #7	#6	#5	#4	#3	#2	#1	#0
G0000	ED7	ED6	ED5	ED4	ED3	ED2	ED1	ED0
G0001	ED15	ED14	ED13	ED12	ED11	ED10	ED9	ED8
G0002	ESTB	EA6	EA5	EA4	EA3	EA2	EA1	EA0
G0003								
G0004			MFIN3	MFIN2	FIN			
G0005		AFL				SFIN		MFIN
G0006				OVC		*ABSM		
G0007		EXLM	*FLWP			ST	STLK	
G0008	ERS	RRW	*SP	*ESP				*IT
G0009					PN8	PN4	PN2	PN1
G0010	*JV7	*JV6	*JV5	*JV4	*JV3	*JV2	*JV1	*JV0
G0011	*JV15	*JV14	*JV13	*JV12	*JV11	*JV10	*JV9	*JV8
G0012	*FV7	*FV6	*FV5	*FV4	*FV3	*FV2	*FV1	*FV0
G0013	*AFV7	*AFV6	*AFV5	*AFV4	*AFV3	*AFV2	*AFV1	*AFV0
G0014							ROV2	ROV1
G0015								
G0016								
G0017								
G0018	HS2D	HS2C	HS2B	HS2A	HS1D	HS1C	HS1B	HS1A
G0019	RT		MP2	MP1				
G0020								
G0021								
G0022								
G0023								
G0024								
G0025								
G0026								

Address table for Series 16/18/21 LCB

Bit No.

Address	#7	#6	#5	#4	#3	#2	#1	#0
G0027								
G0028								
G0029								
G0030								
G0031								
G0032								
G0033								
G0034								
G0035								
G0036								
G0037								
G0038								
G0039								
G0040								
G0041								
G0042								
G0043	ZRN					MD4	MD2	MD1
G0044							MLK	BDT1
G0045	BDT9	BDT8	BDT7	BDT6	BDT5	BDT4	BDT3	BDT2
G0046	DRN	KEY4	KEY3	KEY2	KEY1		SBK	
G0047								
G0048								
G0049								
G0050								
G0051								
G0052								
G0053		SMZ			UINT			
G0054	UI7	UI6	UI5	UI4	UI3	UI2	UI1	UI0
G0055	UI15	UI14	UI13	UI12	UI11	UI10	UI9	UI8

Address table for Series 16/18/21 LCB

Bit No.

Address	#7	#6	#5	#4	#3	#2	#1	#0
G0056								
G0057								
G0058								
G0059								
G0060								
G0061								
G0062								
G0063	NMWT							
G0064								
G0065								
G0066	EKSET						ENBKY	
G0067								
G0068								
G0069								
G0070								
G0071								
G0072								
G0073								
G0074								
G0075								
G0076								
G0077								
G0078								
G0079								
G0080								
G0081								
G0082	Reserved for custom–made macro							
G0083	Reserved for custom–made macro							
G0084								

Address table for Series 16/18/21 LCB

Bit No.

Address	#7	#6	#5	#4	#3	#2	#1	#0
G0085								
G0086								
G0087								
G0088								
G0089								
G0090								
G0091								
G0092								
G0093								
G0094								
G0095								
G0096	HROV	*HROV6	*HROV5	*HROV4	*HROV3	*HROV2	*HROV1	*HROV0
G0097								
G0097	EKC7	EKC6	EKC5	EKC4	EKC3	EKC2	EKC1	EKC0
G0099								
G0100					+J4	+J3	+J2	+J1
G0101								
G0102					–J4	–J3	–J2	–J1
G0103								
G0104								
G0105								
G0106								
G0107								
G0108					MLK4	MLK3	MLK2	MLK1
G0109								
G0110								
G0111								
G0112								
G0113								

Address table for Series 16/18/21 LCB

Bit No.

Address	#7	#6	#5	#4	#3	#2	#1	#0
G0114					*+L4	*+L3	*+L2	*+L1
G0115								
G0116					*–L4	*–L3	*–L2	*–L1
G0117								
G0118								
G0119								
G0120								
G0121								
G0122								
G0123								
G0124								
G0125								
G0126					SVF4	SVF3	SVF2	SVF1
G0127								
G0128								
G0129								
G0130					*IT4	*IT3	*IT2	*IT1
G0131								
G0132								
G0133								
G0134								
G0135								
G0136					EAX4	EAX3	EAX2	EAX1
G0137								
G0138								
G0139								
G0140								
G0141								

Address table for Series 16/18/21 LCB

Bit No.

Address	#7	#6	#5	#4	#3	#2	#1	#0
G0142	EBUFA	ECLRA	ESTPA	ESOFA	ESBKA			EFINA
G0143	EMSBKA	EC6A	EC5A	EC4A	EC3A	EC2A	EC1A	EC0A
G0144	EIF7A	EIF6A	EIF5A	EIF4A	EIF3A	EIF2A	EIF1A	EIF0A
G0145	EIF15A	EIF14A	EIF13A	EIF12A	EIF11A	EIF10A	EIF9A	EIF8A
G0146	EID7A	EID6A	EID5A	EID4A	EID3A	EID2A	EID1A	EID0A
G0147	EID15A	EID14A	EID13A	EID12A	EID11A	EID10A	EID9A	EID8A
G0148	EID23A	EID22A	EID21A	EID20A	EID19A	EID18A	EID17A	EID16A
G0149	EID31A	EID30A	EID29A	EID28A	EID27A	EID26A	EID25A	EID24A
G0150	DRNE	RTE	OVCE				ROV2E	ROV1E
G0151	*FV7E	*FV6E	*FV5E	*FV4E	*FV3E	*FV2E	*FV1E	*FV0E
G0152								
G0153								
G0154	EBUFB	ECLRB	ESTPB	ESOFB	ESBKB			EFINB
G0155	EMSBKB	EC6B	EC5B	EC4B	EC3B	EC2B	EC1B	EC0B
G0156	EIF7B	EIF6B	EIF5B	EIF4B	EIF3B	EIF2B	EIF1B	EIF0B
G0157	EIF15B	EIF14B	EIF13B	EIF12B	EIF11B	EIF10B	EIF9B	EIF8B
G0158	EID7B	EID6B	EID5B	EID4B	EID3B	EID2B	EID1B	EID0B
G0159	EID15B	EID14B	EID13B	EID12B	EID11B	EID10B	EID9B	EID8B
G0160	EID23B	EID22B	EID21B	EID20B	EID19B	EID18B	EID17B	EID16B
G0161	EID31B	EID30B	EID29B	EID28B	EID27B	EID26B	EID25B	EID24B
G0162								
G0163								
G0164								
G0165								

Address table for Series 16/18/21 LCB

Bit No.

Address	#7	#6	#5	#4	#3	#2	#1	#0
G0166	EBUFC	ECLRC	ESTPC	ESOFC	ESBKC			EFINC
G0167	EMSBKC	EC6C	EC5C	EC4C	EC3C	EC2C	EC1C	EC0C
G0168	EIF7C	EIF6C	EIF5C	EIF4C	EIF3C	EIF2C	EIF1C	EIF0C
G0169	EIF15C	EIF14C	EIF13C	EIF12C	EIF11C	EIF10C	EIF9C	EIF8C
G0170	EID7C	EID6C	EID5C	EID4C	EID3C	EID2C	EID1C	EID0C
G0171	EID15C	EID14C	EID13C	EID12C	EID11C	EID10C	EID9C	EID8C
G0172	EID23C	EID22C	EID21C	EID20C	EID19C	EID18C	EID17C	EID16C
G0173	EID31C	EID30C	EID29C	EID28C	EID27C	EID26C	EID25C	EID24C
G0174								
G0175								
G0176								
G0177								
G0178	EBUFD	ECLRD	ESTPD	ESOFD	ESBKD			EFIND
G0179	EMSBKD	EC6D	EC5D	EC4D	EC3D	EC2D	EC1D	EC0D
G0180	EIF7D	EIF6D	EIF5D	EIF4D	EIF3D	EIF2D	EIF1D	EIF0D
G0181	EIF15D	EIF14D	EIF13D	EIF12D	EIF11D	EIF10D	EIF9D	EIF8D
G0182	EID7D	EID6D	EID5D	EID4D	EID3D	EID2D	EID1D	EID0D
G0183	EID15D	EID14D	EID13D	EID12D	EID11D	EID10D	EID9D	EID8D
G0184	EID23D	EID22D	EID21D	EID20D	EID19D	EID18D	EID17D	EID16D
G0185	EID31D	EID30D	EID29D	EID28D	EID27D	EID26D	EID25D	EID24D
G0186								
G0187								
G0188								
G0189								
G0190								
G0191								

Address table for Series 16/18/21 LCB

Address	Bit No. #7	#6	#5	#4	#3	#2	#1	#0
G0212								
G0213								
G0214								
G0215								
G0216								
G0217								
G0218								
G0219								
G0252								
G0253								
G0254								
G0255								
G1212								
G1213								
G1214								
G1215								
G1216								
G1217								
G1218								
G1219								
G1252								
G1253								
G1254								
G1255								

CAUTION

Signals G212 to G219, G252 to G255, G1212 to G1219, and G1252 to G1255 are used for communicating with the NC. The states of the signals in these areas can be checked using F212 to F219, F252 to F255, F1212 to F1219, and F1252 to F1255 on the NC. Note, however, that G1212 to G1219 and G1252 to G1255 are valid only when bit 0 of parameter No. 8102 is set to 1.

CNC→PMC

Address table for Series 16/18/21 LCB

Bit No.

Address	#7	#6	#5	#4	#3	#2	#1	#0
F0000	OP	SA	STL	SPL				RWD
F0001	MA				DEN	BAL	RST	AL
F0002	MDRN	CUT					RPDO	INCH
F0003	MTCHIN	MEDT	MMEM		MMDI	MJ	MH	MINC
F0004			MREF	MAFL	MSBK	MABSM	MMLK	MBDT
F0005	MBDT9	MBDT8	MBDT7	MBDT6	MBDT5	MBDT4	MBDT3	MBDT2
F0006								
F0007						SF		MF
F0008			MF3	MF2				
F0009								
F0010	M07	M06	M05	M04	M03	M02	M01	M00
F0011	M15	M14	M13	M12	M11	M10	M09	M08
F0012	M23	M22	M21	M20	M19	M18	M17	M16
F0013	M31	M30	M29	M28	M27	M26	M25	M24
F0014	M207	M206	M205	M204	M203	M202	M201	M200
F0015	M215	M214	M213	M212	M211	M210	M209	M208
F0016	M307	M306	M305	M304	M303	M302	M301	M300
F0017	M315	M314	M313	M312	M311	M310	M309	M308
F0018								
F0019								
F0020								
F0021								
F0022	S07	S06	S05	S04	S03	S02	S01	S00
F0023	S15	S14	S13	S12	S11	S10	S09	S08
F0024	S23	S22	S21	S20	S19	S18	S17	S16
F0025	S31	S30	S29	S28	S27	S26	S25	S24
F0026								
F0027								

Address table for Series 16/18/21 LCB

Bit No.

Address	#7	#6	#5	#4	#3	#2	#1	#0
F0028								
F0029								
F0030								
F0031								
F0032								
F0033								
F0034								
F0035								
F0036								
F0037								
F0038								
F0039								
F0040								
F0041								
F0042								
F0043								
F0044								
F0045								
F0046								
F0047								
F0048								
F0049								
F0050								
F0051								
F0052								
F0053	EKENB						PRGDPL	INHKY
F0054	UO7	UO6	UO5	UO4	UO3	UO2	UO1	UO0
F0055	UO15	UO14	UO13	UO12	UO11	UO10	UO09	UO08

Address table for Series 16/18/21 LCB

Bit No.

Address	#7	#6	#5	#4	#3	#2	#1	#0
F0056	UO107	UO106	UO105	UO104	UO103	UO102	UO101	UO100
F0057	UO115	UO114	UO113	UO112	UO111	UO110	UO109	UO108
F0058	UO123	UO122	UO121	UO120	UO119	UO118	UO117	UO116
F0059	UO131	UO130	UO129	UO128	UO127	UO126	UO125	UO124
F0060							ESEND	EREND
F0061								
F0062								
F0063		WATO						
F0064								
F0065								
F0066								
F0067								
F0068								
F0069								
F0070	PSW08	PSW07	PSW06	PSW05	PSW04	PSW03	PSW02	PSW01
F0071							PSW10	PSW09
F0072								
F0073								
F0074								
F0075								
F0076								
F0077								
F0078								
F0079								
F0080								
F0081								
F0082								
F0083								
F0084								

Address table for Series 16/18/21 LCB

Bit No.

Address	#7	#6	#5	#4	#3	#2	#1	#0
F0085								
F0086								
F0087								
F0088								
F0089								
F0090								
F0091								
F0092								
F0093								
F0094					ZP4	ZP3	ZP2	ZP1
F0095								
F0096					ZP24	ZP23	ZP22	ZP21
F0097								
F0098					ZP34	ZP33	ZP32	ZP31
F0099								
F0100					ZP44	ZP43	ZP42	ZP41
F0101								
F0102					MV4	MV3	MV2	MV1
F0103								
F0104					INP4	INP3	INP2	INP1
F0105								
F0106					MVD4	MVD3	MVD2	MVD1
F0107								
F0108								
F0109								
F0110								
F0111								
F0112								
F0113								

Address table for Series 16/18/21 LCB

Bit No.

Address	#7	#6	#5	#4	#3	#2	#1	#0
F0114								
F0115								
F0116								
F0117								
F0118								
F0119								
F0120					ZRF4	ZRF3	ZRF2	ZRF1
F0121								
F0122								
F0123								
F0124								
F0125								
F0126								
F0127								
F0128								
F0129	*EAXSL		EOV0					
F0130	EBSYA	EOTNA	EOTP	EGENA	EDENA	EIALA	ECKZA	EINPA
F0131								EMFA
F0132	EM28A	EM24A	EM22A	EM21A	EM18A	EM14A	EM12A	EM11A
F0133	EBSYB	EOTNB	EOTB	EGENB	EDENB	EIALB	ECKZB	EINPB
F0134								EMFB
F0135	EM28B	EM24B	EM22B	EM21B	EM18B	EM14B	EM12B	EM11B
F0136	EBSYC	EOTNC	EOTC	EGENC	EDENC	EIALC	ECKZC	EINPC
F0137								EMFC
F0138	EM28C	EM24C	EM22C	EM21C	EM18C	EM14C	EM12C	EM11C
F0139	EBSYD	EOTND	EOTD	EGEND	EDEND	EIALD	ECKZD	EINPD
F0140								EMFD
F0141	EM28D	EM24D	EM22D	EM21D	EM18D	EM14D	EM12D	EM11D

Address table for Series 16/18/21 LCB

Address	Bit No. #7	#6	#5	#4	#3	#2	#1	#0
F0212								
F0213								
F0214								
F0215								
F0216								
F0217								
F0218								
F0219								
F0252								
F0253								
F0254								
F0255								
F1212								
F1213								
F1214								
F1215								
F1216								
F1217								
F1218								
F1219								
G1252								
G1253								
G1254								
G1255								

CAUTION

Signals F212 to F219, F252 to F255, F1212 to F1219, and F1252 to F1255 are used for communicating with the NC. In these areas, the states of G212 to G219, G252 to G255, F1212 to F1219, and F1252 to F1255 on the NC can be checked. Note, however, that F1212 to F1219 and F1252 to F1255 are valid only when bit 0 of parameter No. 8102 is set to 1.

3 CONNECTING THE LOADER CONTROL BOARD OF THE Series 16*i*/18*i*/21*i*

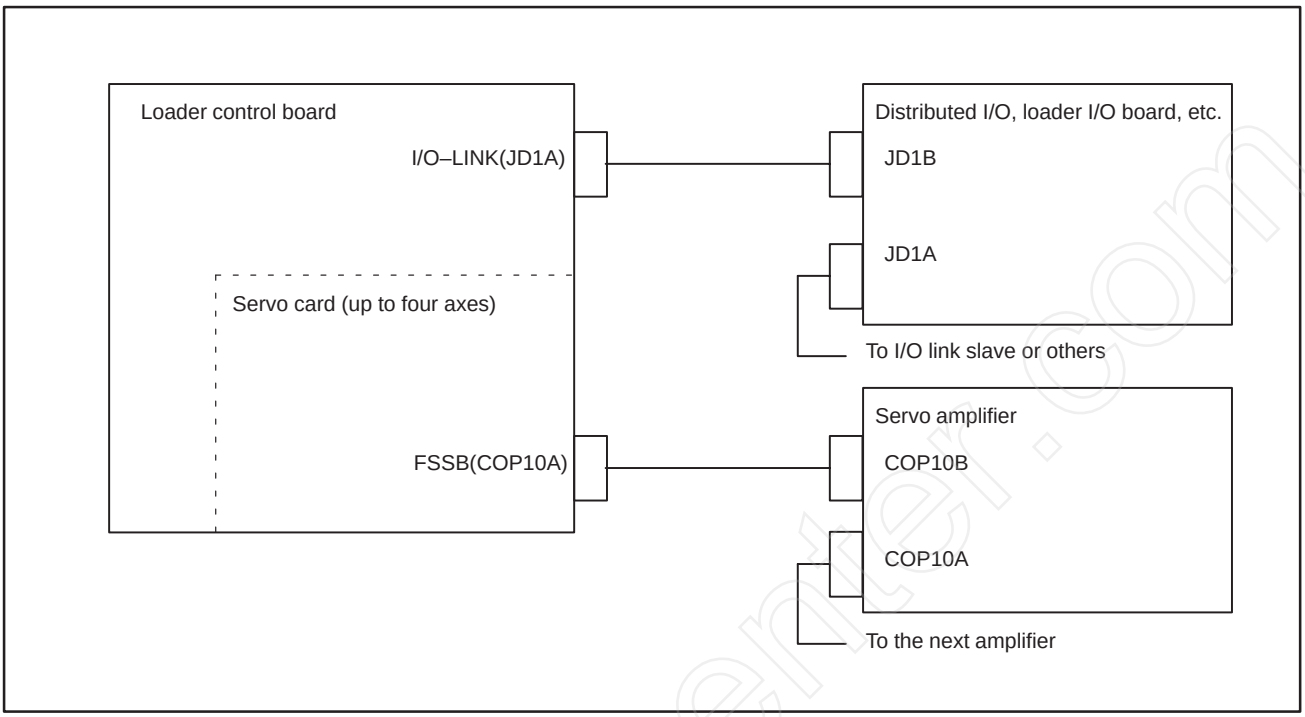
3.1 OUTLINE

The loader control board has been specifically designed for axis control of a loader. The loader control board has the following features and enables axis control independently of the machine.

- For the Series 16/18
- FSSB servo amplifier interface for four axes
- PMC (equivalent to PMC–RA1)
- I/O link interface

This board occupies one optional slot of the Series 16*i*/18*i*/21*i*. The loader control board of the Series 16/18–MODEL A/B/C uses specialized DI/DO signals, but the loader control board of the Series 16*i*/18*i*/21*i* does not. Each DI/DO signal must be connected via an I/O link to an external input/output unit.

3.2 CONNECTION BETWEEN UNITS



3.3 LOADER CONTROL BOARD

Like the other control unit printed circuit boards of the Series 16i/18i/21i, the loader control board is mounted in an optional slot of the control unit. The type of printed circuit board that can be mounted in an optional slot depends on the position of the slot. Some optional slots cannot accommodate the loader control board. Refer to the connection manual (hardware) of the Series 16*i*/18*i*/21*i* for details.

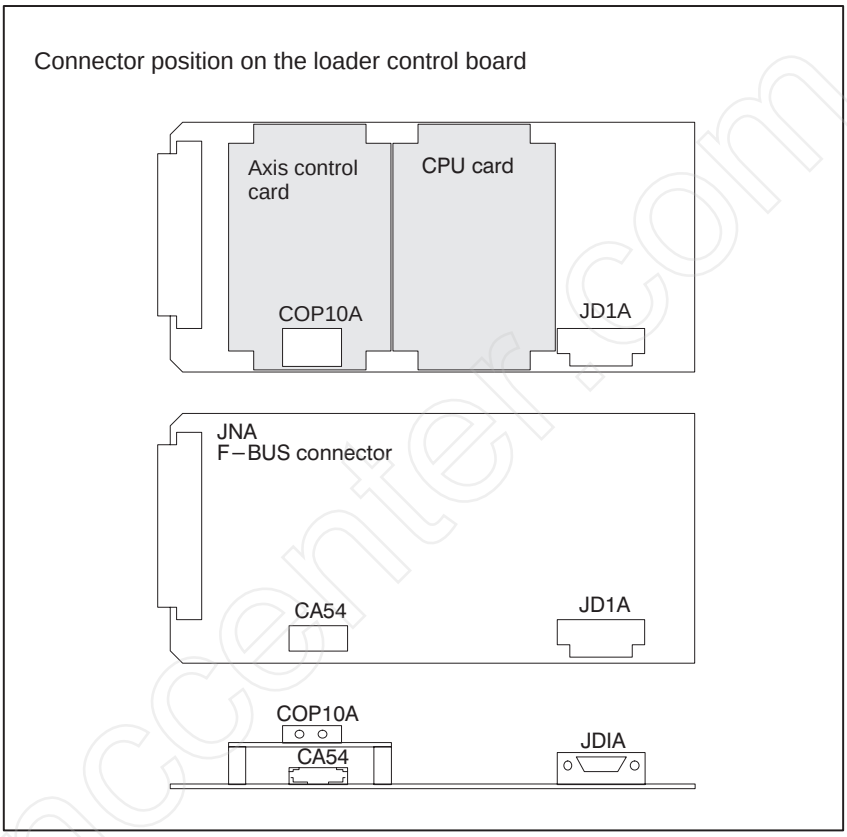


Fig.3.3 Connector Position on the Loader Control Board

3.4 CONNECTING AN I/O LINK

A DI/DO signal necessary for sequence control of the loader must be obtained through an I/O link from a connected external input/output unit.

The external input/output units that can be connected to the I/O link interface on this board include an input/output unit and distributed I/O. Connect the optimum input/output unit for using the DI/DO signal. A loader I/O board having an interface based on the DI/DO signals on the conventional loader control board can be connected via an I/O link. For this type of loader I/O board, see Section 3.7.

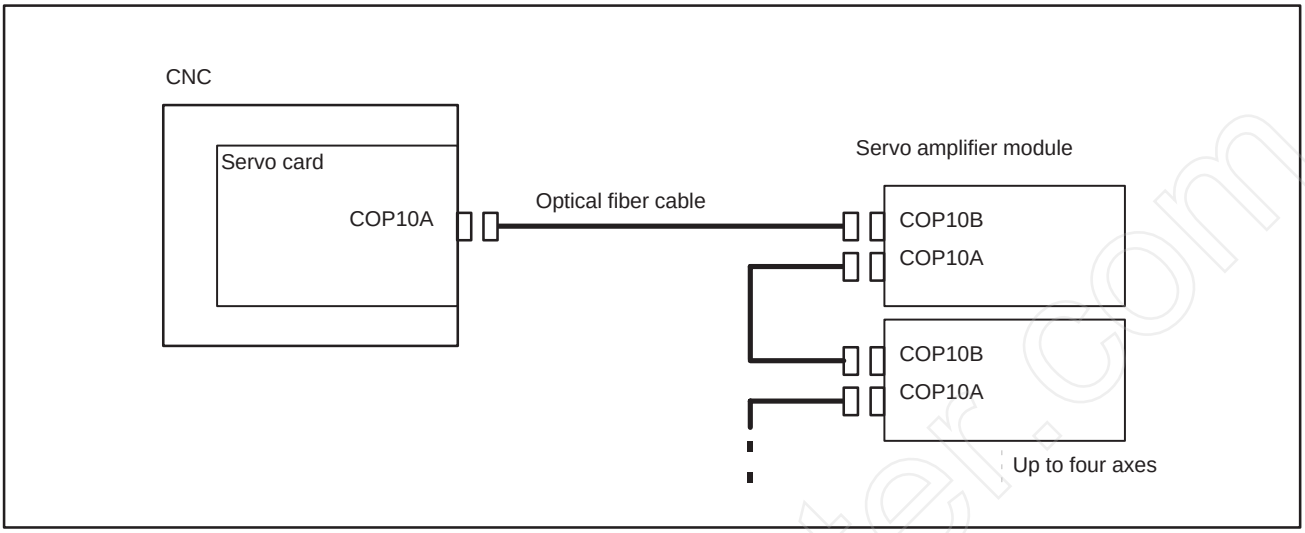
I/O link connector: JD1A

9	+5V	10		19		20	+5V
7		8		17		18	+5V
5		6		15	0V	16	0V
3	SOUT	4	*SOUT	13	0V	14	0V
1	SIN	2	*SIN	11	0V	12	0V

3.5 SERVO INTERFACE (FSSB)

The Series 16*i*/18*i*/21*i* uses an FSSB interface to connect a servo amplifier. An FSSB interface is also provided on the loader control board. When connecting a servo amplifier, use the on–board interface.

The loader control board can control up to four servo axes.



Recommended cable (optical fiber cable)

For use in the power magnetics cabinet/fixed: A66L–6001–0023#LΔΔΔΔ

For use outside the power magnetics cabinet/movable: A66L–6001–0026#LΔΔΔΔ

For the cable length and other notes, refer to the connection manual (hardware) of the Series 16*i*/18*i*/21*i*.

3.6 DI/DO INTERFACE

3.6.1 Interface Signals for the Loader Control CNC

The interface signals between the loader control PMC and the CNC provided in the loader control board are based on the PMC interface signals of the Series 16*i*/18*i*/21*i*. Therefore, ladder programming for the loader PMC can use the same interface as that for the machine PMC. The signals that can be used for loader control are actually limited. See the subsequent sections on DI/DO signals for details.

For details of each function, refer to the following manual:

- FANUC Series 16*i*/18*i*/21*i*/160*i*/180*i*/210*i*–MODEL A CONNECTION MANUAL (Function) (B–63003EN–1)

3.6.2 DI/DO Signals (Function by Function)

Ready	Ready signal Servo ready signal	MA <F001#7> SA <F000#6>
Emergency stop Reset	Emergency stop signal External reset signal Reset & rewind signal Resetting signal Rewinding signal	*ESP <G008#4, X000#7> ERS <G008#7> RRW <G008#6> RST <F001#1> RWD <F000#0>
Status signal	Alarm signal Battery alarm signal Axial moving signal Axial moving direction signal In–position signal Rapid traverse signal Inch input signal Cutting feed signal	AL <F001#0> BAL <F001#2> MV1 – MV4 <F102#0 – #3> MVD1 – MVD4 <F106#0 – #3> INP1 – INP4 <F104#0 – #3> RPDO <F002#1> INCH <F002#0> CUT <F002#6>
Mode selection	Mode selection signal Operation mode confirmation signal	MD1, MD2, MD4 <G043#0 – #2> MMDI <F003#3> MMEM <F003#5> MEDT <F003#6> MH <F003#1> MINC <F003#0> MJ <F003#2> MREF <F004#5> MTCHIN <F003#7>
Jog feed	Feed axis direction selection signal Manual feedrate override signal Manual rapid traverse selection signal Rapid traverse override signal 1% rapid traverse override select signal 1% rapid traverse override signal Manual absolute signal Absolute switch confirmation signal	+J1 – +J4 <G100#0 – #3> – J1 – – J4 <G102#0 – #3> *JV0 – *JV15 <G010 – G011> RT <G019#7> ROV1, ROV2 <G014#0, #1> HROV <G096#7> *HROV0 – *HROV6 <G096#0 – #6> *ABSM <G006#2> MABSM <F004#2>
Interlock	Start lock signal Interlock signal for all axes Interlock signal for each axis	STLK <G007#1> *IT <G008#0> *IT1 – *IT4 <G130#0 – #3>
Manual handle feed, incremental feed	Manual handle feed axis select signal Incremental feed signal (Manual handle feed movement amount select signal)	HS1A, HS1B, HS1C, HS1D <G018#0 – #3> HS2A, HS2B, HS2C, HS2D <G018#4 – #7> MP1, MP2 <G019#4, #5>
Reference position return	Manual reference position return select signal Deceleration signal for reference position return signal Reference position return completion signal 2nd reference position return completion signal 3rd reference position return completion signal 4th reference position return completion signal Reference position establishment signal	ZRN <G043#7> *DEC1 – *DEC4 <X000#0 – #3> ZP1 – ZP4 <F094#0 – #3> ZP21 – ZP24 <F096#0 – #3> ZP31 – ZP34 <F098#0 – #3> ZP41 – ZP44 <F100#0 – #3> ZRF1 – ZRF4 <F120#0 – #3>
Memory protect key	Memory protect signal	KEY1 – KEY4 <G046#3 – #6>

Automatic operation	Cycle start signal	ST <G007#2>
	Feed hold signal	*SP <G008#5>
	Cycle start LED signal	STL <F000#5>
	Feed hold LED signal	SPL <F000#4>
	Automatic operating signal	OP <F000#7>
	Workpiece number search signal	PN1 – PN8 <G009#0 – #3>
	Machine lock signal for all axes	MLK <G044#1>
	Machine lock signal for each axis	MLK1 – MLK4 <G108#0 – #3>
	Machine lock confirmation signal for all axes	MMLK <F004#1>
	Single block signal	SBK <G046#1>
	Single block confirmation signal	MSBK <F004#3>
	Feedrate override signal	*FV0 – *FV7 <G012>
	2nd feedrate override signal	*AFV0 – *AFV7 <G013>
	Override cancel signal	OVC <G006#4>
	Dry run signal	DRN <G046#7>
	Dry run confirmation signal	MDRN <F002#7>
	Optional block skip signal	BDT1 <G044#0>
		BDT2 – BDT9 <G045#0 – #7>
	Optional block skip confirmation signal	MBDT1 <F004#0>
		MBDT2 – MBDT9 <F005#0 – #7>
	Error detect signal	SMZ <G053#6>
Auxiliary function	Auxiliary function code signal	M00 – M31 <F010 – F013>
	Auxiliary function strobe signal	MF <F007#0>
	Finish signal	FIN <G004#3>
	Auxiliary function finish signal	MFIN <G005#0>
	Distribution end signal	DEN <F001#3>
	Auxiliary function lock signal	AFL <G005#6>
	Auxiliary function lock confirmation signal	MAFL <F004#4>
Multiple M commands	2nd M function code signal	M200 – M215 <F014 – F015>
	2nd M function strobe signal	MF2 <F008#4>
	2nd M function finish signal	MFIN2 <G004#4>
	3rd M function code signal	M300 – M315 <F016 – F017>
	3rd M function strobe signal	MF3 <F008#5>
	3rd M function finish signal	MFIN3 <G004#5>
S function	S function code signal	S0 – S31 <F022 – F025>
	S function strobe signalS	SF <F007#2>
	S function finish signal	SFIN <G005#2>
Skip function	Skip signal	SKIP <X002#7>
Overtravel	Overtravel signal	*+L1 – *+L4 <G114#0 – #3>
		*– L1 – *– L4 <G116#0 – #3>
	Stored stroke check switch signal	EXLM <G007#6>
	Loader overtravel signal	*LOT <X000#6>
Mechanical handle feed	Servo off signal	SVF1 – SVF4 <G126#0 – #3>
	Follow–up signal	*FLWU <G007#5>
External data input	1) External alarm message function	
	2) External operation message function	
	3) External program number search function	
	Data signal	ED00 – ED15 <G000 – G001>
	Address signal	EA0 – EA6 <G002#0 – #6>
	Read signal	ESTB <G002#7>
	Read finish signal	EREND <F060#0>
	Search finish signal	ESEND <F060#1>
Custom macro	Input signal for custom macro	UI0 – UI15 <G054 – G055>
	Output signal for custom macro	UO0 – UO15 <F054 – F055>
		UO100 – UO131 <F056 – F059>
	Interrupt signal for custom macro	UINT <G053#3>
Position switch function	Position switch signal	PSW01 – PSW10 <F070#0 – F071#1>

Axis control function by PMC		
1) Group A	Axis control command signal	EC0A – EC6A <G143#0 – #6>
	Axis control command read signal	EBUFA <G142#7>
	Axis control command read finish signal	EBSYA <F130#7>
	Reset signal	ECLRA <G142#6>
	Axis control temporary stop signal	ESTPA <G142#5>
	Servo off signal	ESOFA <G142#4>
	Block stop signal	ESBKA <G142#3>
	Block stop disable signal	EMSBKA <G143#7>
	Auxiliary function code signal	EM11A – EM28A <F132>
	Auxiliary function strobe signal	EMFA <F131#0>
	Auxiliary function completion signal	EFINA <G142#0>
	Axis control feedrate signal	EIF0A – EIF15A <G144 – G145>
	Axis control data signal	EID0A – EID31A <G146 – G149>
	In–position signal	EINPA <F130#0>
	Following zero checking signal	ECKZA <F130#1>
	Alarm signal	EIALA <F130#2>
	Axis moving signal	EGENA <F130#4>
	Auxiliary function executing signal	EDENA <F130#3>
	Negative–direction overtravel signal	EOTNA <F130#6>
	Positive–direction overtravel signal	EOTPA <F130#5>
2) Group B	Axis control command signal	EC0B – EC6B <G155#0 – #6>
	Axis control command read signal	EBUFB <G154#7>
	Axis control command read finish signal	EBSYB <F133#7>
	Reset signal	ECLRB <G154#6>
	Axis control temporary stop signal	ESTPB <G154#5>
	Servo off signal	ESOFB <G154#4>
	Block stop signal	ESBKB <G154#3>
	Block stop disable signal	EMSBKB <G155#7>
	Auxiliary function code signal	EM11B – EM28B <F135>
	Auxiliary function strobe signal	EMFB <F134#0>
	Auxiliary function completion signal	EFINB <G154#0>
	Axis control feedrate signal	EIF0B – EIF15B <G156 – G157>
	Axis control data signal	EID0B – EID31B <G158 – G161>
	In–position signal	EINPB <F133#0>
	Following zero checking signal	ECKZB <F133#1>
	Alarm signal	EIALB <F133#2>
	Axis moving signal	EGENB <F133#4>
	Auxiliary function executing signal	EDENB <F133#3>
	Negative–direction overtravel signal	EOTNB <F133#6>
	Positive–direction overtravel signal	EOTPB <F133#5>
3) Group C	Axis control command signal	EC0C – EC6C <G167#0 – #6>
	Axis control command read signal	EBUFC <G166#7>
	Axis control command read finish signal	EBSYC <F136#7>
	Reset signal	ECLRC <G166#6>
	Axis control temporary stop signal	ESTPC <G166#5>
	Servo off signal	ESOFC <G166#4>
	Block stop signal	ESBKC <G166#3>
	Block stop disable signal	EMSBKC <G167#7>
	Auxiliary function code signal	EM11C – EM28C <F138>
	Auxiliary function strobe signal	EMFC <F137#0>
	Auxiliary function completion signal	EFINC <G166#0>
	Axis control feedrate signal	EIF0C – EIF15C <G168 – G169>
	Axis control data signal	EID0C – EID31C <G170 – G173>
	In–position signal	EINPC <F136#0>
	Following zero checking signal	ECKZC <F136#1>
	Alarm signal	EIALC <F136#2>
	Axis moving signal	EGENC <F136#4>
	Auxiliary function executing signal	EDENC <F136#3>
	Negative–direction overtravel signal	EOTNC <F136#6>
	Positive–direction overtravel signal	EOTPC <F136#5>

4) Group A	Axis control command signal	EC0D – EC6D <G179#0 – #6>
	Axis control command read signal	EBUFD <G178#7>
	Axis control command read finish signal	EBSYD <F139#7>
	Reset signal	ECLRD <G178#6>
	Axis control temporary stop signal	ESTPD <G178#5>
	Servo off signal	ESOFD <G178#4>
	Block stop signal	ESBKD <G178#3>
	Block stop disable signal	EMSBKD <G179#7>
	Auxiliary function code signal	EM11D – EM28D <F141>
	Auxiliary function strobe signal	EMFD <F140#0>
	Auxiliary function completion signal	EFIND <G178#0>
	Axis control feedrate signal	EIF0D – EIF15D <G180 – G181>
	Axis control data signal	EID0D – EID31D <G182 – G185>
	In–position signal	EINPD <F139#0>
	Following zero checking signal	ECKZD <F139#1>
	Alarm signal	EIALD <F139#2>
	Axis moving signal	EGEND <F139#4>
	Auxiliary function executing signal	EDEND <F139#3>
	Negative–direction overtravel signal	EOTND <F139#6>
	Positive–direction overtravel signal	EOTPD <F139#5>
5) Common	Control axis select signal	EAX1 – EAX4 <G136#0 – #3>
	Control axis selection status signal	*EAXSL <F129#7>
	Feedrate override signal	*FV0E – *FV7E <G151>
	Override cancellation signal	OVCE <G150#5>
	Rapid traverse override signal	ROV1E, ROV2E <G150#0, #1>
	Dry run signal	DRNE <G150#7>
	Manual rapid traverse select signal	RTE <G150#6>
External key input control		EKSET <G066#7> ENBKY <G066#1> EKC0 – EKC7 <G098> INHKY <F053#0> PRGDPL <F053#1> EKENB <F053#7>
Communication signal between LCB and NC		(G0212 – G0219) (G0252 – G0255) (G1212 – G1219) (G1252 – G1255) (F0212 – F0219) (F0252 – F0255) (F1212 – F1219) (F1252 – F1255)
Multi–path waiting by M code	3–path waiting ignorance signal	NMWT <G063#7>
	Waiting signal	WATO <F063#6>

3.6.3 DI/DO Signals (In Order of Addresses)

Address table for series 16*i*/18*i*/21*i* LCB

MT→PMC

Bit No.

Address	7	6	5	4	3	2	1	0
X000	*EMG1				*DEC4	*DEC3	*DEC2	*DEC1
X001								
X002	SKIP							

PMC→CNC

Bit No.

Address	7	6	5	4	3	2	1	0
G0000	ED7	ED6	ED5	ED4	ED3	ED2	ED1	ED0
G0001	ED15	ED14	ED13	ED12	ED11	ED10	ED9	ED8
G0002	ESTB	EA6	EA5	EA4	EA3	EA2	EA1	EA0
G0003								
G0004			MFIN3	MFIN2	FIN			
G0005		AFL				SFIN		MFIN
G0006				OVC		*ABSM		
G0007		EXLM	*FLWP			ST	STLK	
G0008	ERS	RRW	*SP	*ESP				*IT
G0009					PN8	PN4	PN2	PN1
G0010	*JV7	*JV6	*JV5	*JV4	*JV3	*JV2	*JV1	*JV0
G0011	*JV15	*JV14	*JV13	*JV12	*JV11	*JV10	*JV9	*JV8
G0012	*FV7	*FV6	*FV5	*FV4	*FV3	*FV2	*FV1	*FV0
G0013	*AFV7	*AFV6	*AFV5	*AFV4	*AFV3	*AFV2	*AFV1	*AFV0
G0014							ROV2	ROV1
G0015								
G0016								
G0017								
G0018	HS2D	HS2C	HS2B	HS2A	HS1D	HS1C	HS1B	HS1A
G0019	RT		MP2	MP1				

Address table for series 16*i*/18*i*/21*i* LCB

Bit No.

Address	7	6	5	4	3	2	1	0
G0020								
G0021								
G0022								
G0023								
G0024								
G0025								
G0026								
G0027								
G0028								
G0029								
G0030								
G0031								
G0032								
G0033								
G0034								
G0035								
G0036								
G0037								
G0038								
G0039								
G0040								
G0041								
G0042								
G0043	ZRN					MD4	MD2	MD1
G0044							MLK	BDT1
G0045	BDT9	BDT8	BDT7	BDT6	BDT5	BDT4	BDT3	BDT2
G0046	DRN	KEY4	KEY3	KEY2	KEY1		SBK	
G0047								
G0048								
G0049								

Address table for series 16*i*/18*i*/21*i* LCB

Bit No.

Address	7	6	5	4	3	2	1	0
G0050								
G0051								
G0052								
G0053		SMZ			UINT			
G0054	UI7	UI6	UI5	UI4	UI3	UI2	UI1	UI0
G0055	UI15	UI14	UI13	UI12	UI11	UI10	UI9	UI8
G0056								
G0057								
G0058								
G0059								
G0060								
G0061								
G0062								
G0063	NMWT							
G0064								
G0065								
G0066	EKSET						ENBKY	
G0067								
G0068								
G0069								
G0070								
G0071								
G0072								
G0073								
G0074								
G0075								
G0076								
G0077								
G0078								
G0079								

Address table for series 16*i*/18*i*/21*i* LCB

Bit No.

Address	7	6	5	4	3	2	1	0
G0080								
G0081								
G0082	Reserved for order made macro							
G0083	Reserved for order made macro							
G0084								
G0085								
G0086								
G0087								
G0088								
G0089								
G0090								
G0091								
G0092								
G0093								
G0094								
G0095								
G0096	HROV	*HROV6	*HROV5	*HROV4	*HROV3	*HROV2	*HROV1	*HROV0
G0097								
G0098	EKC7	EKC6	EKC5	EKC4	EKC3	EKC2	EKC1	EKC0
G0099								
G0100					+J4	+J3	+J2	+J1
G0101								
G0102					–J4	–J3	–J2	–J1
G0103								
G0104								
G0105								
G0106								
G0107								
G0108					MLK4	MLK3	MLK2	MLK1
G0109								

Address table for series 16*i*/18*i*/21*i* LCB

Bit No.

Address	7	6	5	4	3	2	1	0
G0110								
G0111								
G0112								
G0113								
G0114					*+L4	*+L3	*+L2	*+L1
G0115								
G0116					*–L4	*–L3	*–L2	*–L1
G0117								
G0118								
G0119								
G0120								
G0121								
G0122								
G0123								
G0124								
G0125								
G0126					SVF4	SVF3	SVF2	SVF1
G0127								
G0128								
G0129								
G0130					*IT4	*IT3	*IT2	*IT1
G0131								
G0132								
G0133								
G0134								
G0135								
G0136					EAX4	EAX3	EAX2	EAX1
G0137								
G0138								
G0139								

Address table for series 16*i*/18*i*/21*i* LCB

Bit No.

Address	7	6	5	4	3	2	1	0
G0140								
G0141								
G0142	EBUFA	ECLRA	ESTPA	ESOFA	ESBKA			EFINA
G0143	EMSBKA	EC6A	EC5A	EC4A	EC3A	EC2A	EC1A	EC0A
G0144	EIF7A	EIF6A	EIF5A	EIF4A	EIF3A	EIF2A	EIF1A	EIF0A
G0145	EIF15A	EIF14A	EIF13A	EIF12A	EIF11A	EIF10A	EIF9A	EIF8A
G0146	EID7A	EID6A	EID5A	EID4A	EID3A	EID2A	EID1A	EID0A
G0147	EID15A	EID14A	EID13A	EID12A	EID11A	EID10A	EID9A	EID8A
G0148	EID23A	EID22A	EID21A	EID20A	EID19A	EID18A	EID17A	EID16A
G0149	EID31A	EID30A	EID29A	EID28A	EID27A	EID26A	EID25A	EID24A
G0150	DRNE	RTE	OVCE				ROV2E	ROV1E
G0151	*FV7E	*FV6E	*FV5E	*FV4E	*FV3E	*FV2E	*FV1E	*FV0E
G0152								
G0153								
G0154	EBUFB	ECLRB	ESTPB	ESOFB	ESBKB			EFINB
G0155	EMSBKB	EC6B	EC5B	EC4B	EC3B	EC2B	EC1B	EC0B
G0156	EIF7B	EIF6B	EIF5B	EIF4B	EIF3B	EIF2B	EIF1B	EIF0B
G0157	EIF15B	EIF14B	EIF13B	EIF12B	EIF11B	EIF10B	EIF9B	EIF8B
G0158	EID7B	EID6B	EID5B	EID4B	EID3B	EID2B	EID1B	EID0B
G0159	EID15B	EID14B	EID13B	EID12B	EID11B	EID10B	EID9B	EID8B
G0160	EID23B	EID22B	EID21B	EID20B	EID19B	EID18B	EID17B	EID16B
G0161	EID31B	EID30B	EID29B	EID28B	EID27B	EID26B	EID25B	EID24B
G0162								
G0163								
G0164								
G0165								
G0166	EBUFC	ECLRC	ESTPC	ESOFC	ESBKC			EFINC
G0167	EMSBKC	EC6C	EC5C	EC4C	EC3C	EC2C	EC1C	EC0C
G0168	EIF7C	EIF6C	EIF5C	EIF4C	EIF3C	EIF2C	EIF1C	EIF0C
G0169	EIF15C	EIF14C	EIF13C	EIF12C	EIF11C	EIF10C	EIF9C	EIF8C

Address table for series 16*i*/18*i*/21*i* LCB

Address	Bit No. 7	6	5	4	3	2	1	0
G0170	EID7C	EID6C	EID5C	EID4C	EID3C	EID2C	EID1C	EID0C
G0171	EID15C	EID14C	EID13C	EID12C	EID11C	EID10C	EID9C	EID8C
G0172	EID23C	EID22C	EID21C	EID20C	EID19C	EID18C	EID17C	EID16C
G0173	EID31C	EID30C	EID29C	EID28C	EID27C	EID26C	EID25C	EID24C
G0174								
G0175								
G0176								
G0177								
G0178	EBUFD	ECLRD	ESTPD	ESOFD	ESBKD			EFIND
G0179	EMSBKD	EC6D	EC5D	EC4D	EC3D	EC2D	EC1D	EC0D
G0180	EIF7D	EIF6D	EIF5D	EIF4D	EIF3D	EIF2D	EIF1D	EIF0D
G0181	EIF15D	EIF14D	EIF13D	EIF12D	EIF11D	EIF10D	EIF9D	EIF8D
G0182	EID7D	EID6D	EID5D	EID4D	EID3D	EID2D	EID1D	EID0D
G0183	EID15D	EID14D	EID13D	EID12D	EID11D	EID10D	EID9D	EID8D
G0184	EID23D	EID22D	EID21D	EID20D	EID19D	EID18D	EID17D	EID16D
G0185	EID31D	EID30D	EID29D	EID28D	EID27D	EID26D	EID25D	EID24D
G0186								
G0187								
G0188								
G0189								
G0190								
G0191								

Address table for series 16*i*/18*i*/21*i* LCB

Address	Bit No. 7	6	5	4	3	2	1	0
G0212								
G0213								
G0214								
G0215								
G0216								
G0217								
G0218								
G0219								
G0252								
G0253								
G0254								
G0255								
G1212								
G1213								
G1214								
G1215								
G1216								
G1217								
G1218								
G1219								
G1252								
G1253								
G1254								
G1255								

CAUTION

Signals G212 to G219, G252 to G255, G1212 to G1219, and G1252 to G1255 are used for communicating with the CNC. The states of the signals in these areas can be checked using F212 to F219, F252 to F255, F1212 to F1219, and F1252 to F1255 on the CNC. Note that G1212 to G1219 and G1252 to G1255 are valid only when the S19 bit (bit 0 of parameter 8102) is set to 1.

CNC→PMC

Address table for series 16*i*/18*i*/21*i* LCB

Address	Bit No. 7	6	5	4	3	2	1	0
F0000	OP	SA	STL	SPL				RWD
F0001	MA				DEN	BAL	RST	AL
F0002	MDRN	CUT					RPDO	INCH
F0003	MTCHIN	MEDT	MMEM		MMDI	MJ	MH	MINC
F0004			MREF	MAFL	MSBK	MABSM	MMLK	MBDT
F0005	MBDT9	MBDT8	MBDT7	MBDT6	MBDT5	MBDT4	MBDT3	MBDT2
F0006								
F0007						SF		MF
F0008			MF3	MF2				
F0009								
F0010	M07	M06	M05	M04	M03	M02	M01	M00
F0011	M15	M14	M13	M12	M11	M10	M09	M08
F0012	M23	M22	M21	M20	M19	M18	M17	M16
F0013	M31	M30	M29	M28	M27	M26	M25	M24
F0014	M207	M206	M205	M204	M203	M202	M201	M200
F0015	M215	M214	M213	M212	M211	M210	M209	M208
F0016	M307	M306	M305	M304	M303	M302	M301	M300
F0017	M315	M314	M313	M312	M311	M310	M309	M308
F0018								
F0019								
F0020								
F0021								
F0022	S07	S06	S05	S04	S03	S02	S01	S00
F0023	S15	S14	S13	S12	S11	S10	S09	S08
F0024	S23	S22	S21	S20	S19	S18	S17	S16
F0025	S31	S30	S29	S28	S27	S26	S25	S24
F0026								
F0027								

Address table for series 16*i*/18*i*/21*i* LCB

Bit No.

Address	7	6	5	4	3	2	1	0
F0028								
F0029								
F0030								
F0031								
F0032								
F0033								
F0034								
F0035								
F0036								
F0037								
F0038								
F0039								
F0040								
F0041								
F0042								
F0043								
F0044								
F0045								
F0046								
F0047								
F0048								
F0049								
F0050								
F0051								
F0052								
F0053	EKENB						PRGDPL	INHKY
F0054	UO7	UO6	UO5	UO4	UO3	UO2	UO1	UO0
F0055	UO15	UO14	UO13	UO12	UO11	UO10	UO09	UO08

Address table for series 16*i*/18*i*/21*i* LCB

Bit No.

Address	7	6	5	4	3	2	1	0
F0056	UO107	UO106	UO105	UO104	UO103	UO102	UO101	UO100
F0057	UO115	UO114	UO113	UO112	UO111	UO110	UO109	UO108
F0058	UO123	UO122	UO121	UO120	UO119	UO118	UO117	UO116
F0059	UO131	UO130	UO129	UO128	UO127	UO126	UO125	UO124
F0060							ESEND	EREND
F0061								
F0062								
F0063		WATO						
F0064								
F0065								
F0066								
F0067								
F0068								
F0069								
F0070	PSW08	PSW07	PSW06	PSW05	PSW04	PSW03	PSW02	PSW01
F0071							PSW10	PSW09
F0072								
F0073								
F0074								
F0075								
F0076								
F0077								
F0078								
F0079								
F0080								
F0081								
F0082								
F0083								
F0084								

Address table for series 16*i*/18*i*/21*i* LCB

Address	Bit No. 7	6	5	4	3	2	1	0
F0085								
F0086								
F0087								
F0088								
F0089								
F0090								
F0091								
F0092								
F0093								
F0094					ZP4	ZP3	ZP2	ZP1
F0095								
F0096					ZP24	ZP23	ZP22	ZP21
F0097								
F0098					ZP34	ZP33	ZP32	ZP31
F0099								
F0100					ZP44	ZP43	ZP42	ZP41
F0101								
F0102					MV4	MV3	MV2	MV1
F0103								
F0104					INP4	INP3	INP2	INP1
F0105								
F0106					MVD4	MVD3	MVD2	MVD1
F0107								
F0108								
F0109								
F0110								
F0111								
F0112								
F0113								

Address table for series 16*i*/18*i*/21*i* LCB

Address	Bit No. 7	6	5	4	3	2	1	0
F0114								
F0115								
F0116								
F0117								
F0118								
F0119								
F0120					ZRF4	ZRF3	ZRF2	ZRF1
F0121								
F0122								
F0123								
F0124								
F0125								
F0126								
F0127								
F0128								
F0129	*EAXSL		EOV0					
F0130	EBSYA	EOTNA	EOTP	EGENA	EDENA	EIALA	ECKZA	EINPA
F0131								EMFA
F0132	EM28A	EM24A	EM22A	EM21A	EM18A	EM14A	EM12A	EM11A
F0133	EBSYB	EOTNB	EOTB	EGENB	EDENB	EIALB	ECKZB	EINPB
F0134								EMFB
F0135	EM28B	EM24B	EM22B	EM21B	EM18B	EM14B	EM12B	EM11B
F0136	EBSYC	EOTNC	EOTC	EGENC	EDENC	EIALC	ECKZC	EINPC
F0137								EMFC
F0138	EM28C	EM24C	EM22C	EM21C	EM18C	EM14C	EM12C	EM11C
F0139	EBSYD	EOTND	EOTD	EGEND	EDEND	EIALD	ECKZD	EINPD
F0140								EMFD
F0141	EM28D	EM24D	EM22D	EM21D	EM18D	EM14D	EM12D	EM11D

Address table for series 16*i*/18*i*/21*i* LCB

Bit No.

	7	6	5	4	3	2	1	0
F0212								
F0213								
F0214								
F0215								
F0216								
F0217								
F0218								
F0219								
F0252								
F0253								
F0254								
F0255								
F1212								
F1213								
F1214								
F1215								
F1216								
F1217								
F1218								
F1219								
G1252								
G1253								
G1254								
G1255								

CAUTION

Signals F212 to F219, F252 to F255, F1212 to F1219, and F1252 to F1255 are used for communicating with the CNC. In these areas, the states of G212 to G219, G252 to G255, G1212 to G1219, and G1252 to G1255 on the CNC can be checked. Note that F1212 to F1219 and F1252 to F1255 are valid only when the S19 bit (bit 0 of parameter 8102) is set to 1.

3.7 LOADER I/O BOARD

3.7.1 Outline

This board has an I/O function based on the loader–specialized I/O signals provided on the loader control board of the Series 16/18–MODEL A/B/C. The board is connected, via an I/O link, to the CNC.

The interface is basically compatible with the I/O signals provided on the loader control board of the Series 16/18, but the general DO signals are source output. The board does not support matrix expansion of the operator's panel interface.

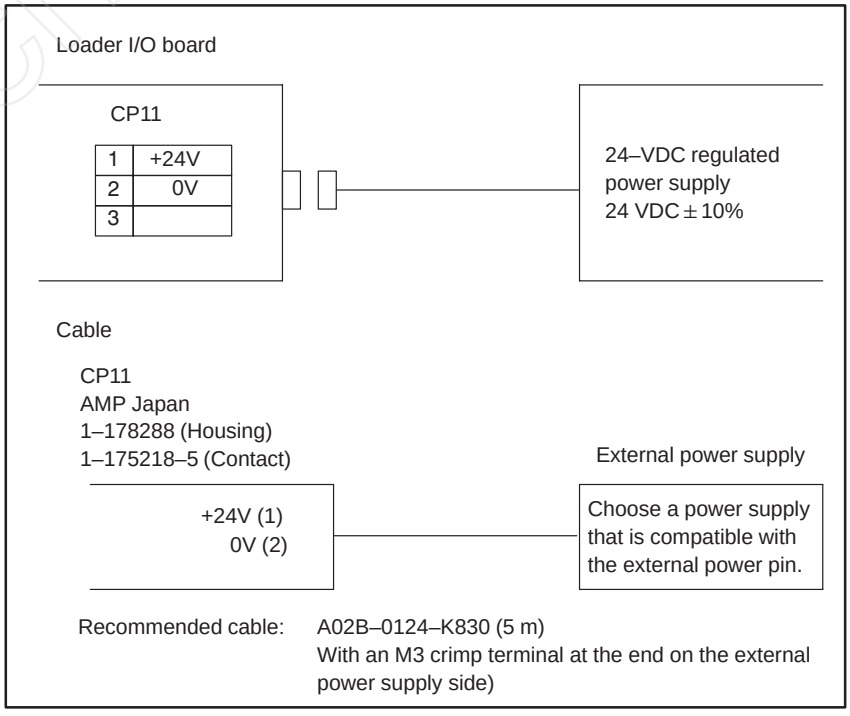
3.7.2 Power Connection

A voltage of 24 VDC is supplied externally. Use a power supply rated at 2 A or higher.

3.7.2.1 Connector

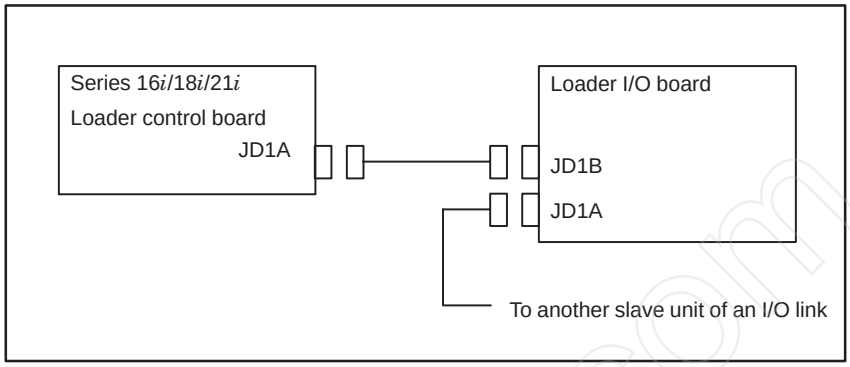
A3	A2	A1
	0V	+24V
B3	B2	B1
	0V	+24V

3.7.2.2 Connection



3.7.3 Connecting an I/O Link

This board is connected as a slave unit of an I/O link via the I/O link interface of the loader control board.



3.7.3.1 Addressing an I/O Link

This board occupies five bytes for each of input and output. Use the following module names:

Input:/5

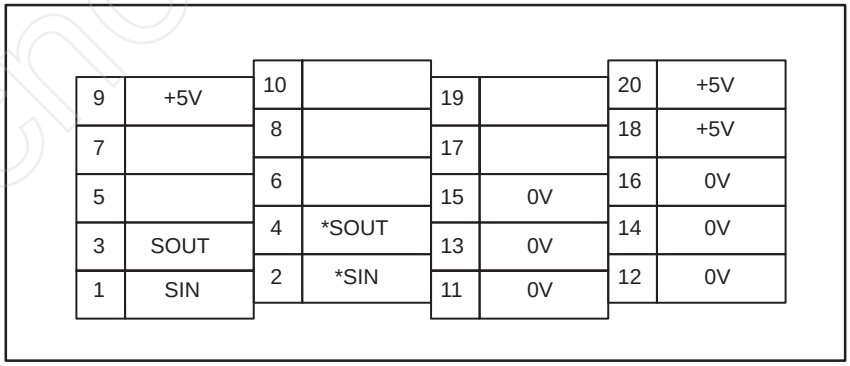
Output:/5

For such addressing, it is recommended that the address of this board begin with X0 and Y0. This section assumes that the loader I/O board is addressed X0 and Y0.

3.7.3.2 Connector

Connector pin layout on the loader I/O board side

JD1A, JD1B (PCR–EV20MDT)



3.7.4 Connecting the Loader Operator's Panel

The loader operator's panel is used to jog the loader and to perform teaching. For the loader operator's panel, the I/O signals described below are stored on the loader I/O board.

3.7.4.1 Outline

DI = 8 points (24–V input)

DO = 6 points (24–V sink output)

DO = 4 points (24–V source output)

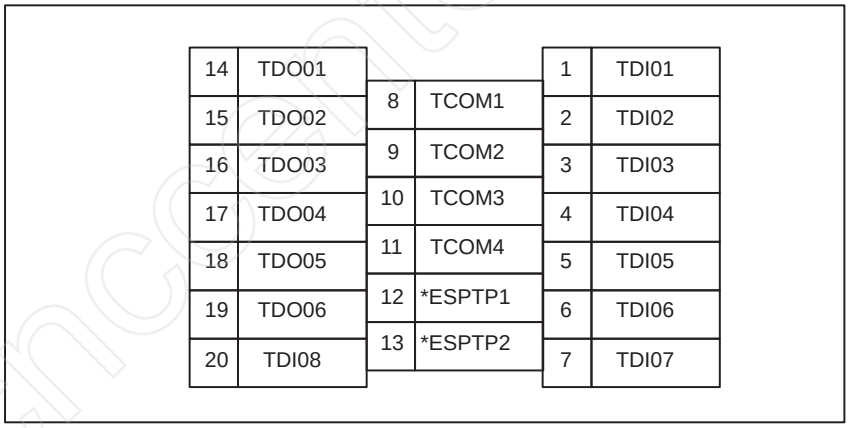
DI = 1 point (24–V input for emergency stop)

These I/O signals are used for switch input of the loader operator's panel and for driving the LED display.

3.7.4.2 Connector

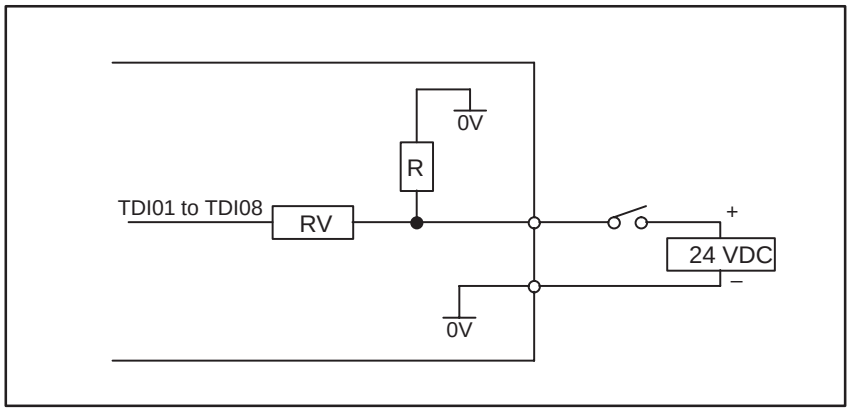
Connector pin layout on the loader I/O board side

CNTP (MR20–pin, male)

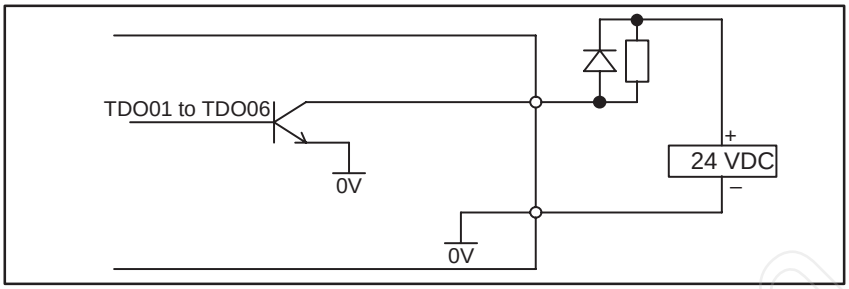


3.7.4.3 Connection

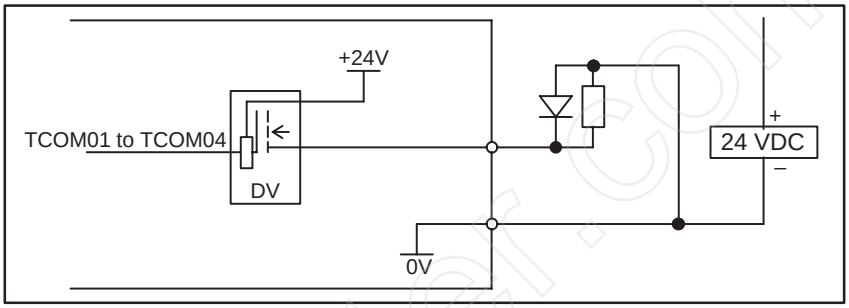
- TDI01 to TDI08



- TDO01 to TDO06



- TCOM01 to TCOM04



* Connect the common voltage line of the source driver to +24 V on the same board.

3.7.4.4 Signals

Operator's panel input signals TDI01 to TDI08

Classification : 24–V input, tied to common 24 V
Function : TDI01 to TDI08 can be used as eight general–purpose DI signals.

Operator's panel output signals TDO01 to TDO06

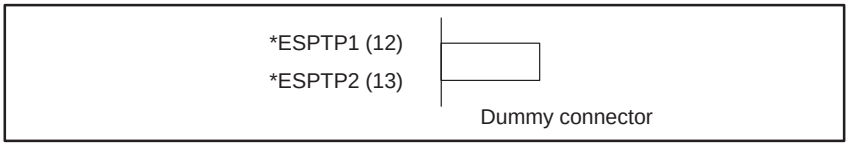
Classification : 24–V sink output, 24–V/220–mA load
Function : TDO01 to TDO06 can be used as six general–purpose DO signals.

Common voltage drive output signals TCOM1 to TCOM4

Classification : 24–V source output, 24–V/200–mA load
Function : A source driver is used to output 24 V to a signal pin when the corresponding signal is set to 1 by the PMC.

Emergency stop input signals *ESPTP1, *ESPTP2

Classification : 24–V input for emergency stop
Function : The contact signal from the emergency stop button on the operator's panel is connected in series with *LOT within the loader I/O board. This signal drives the externally mounted emergency stop control relay. See also Section 3.7.7, "Connecting an Emergency Stop System." Connect contact B of the emergency stop button on the loader operator's panel to *ESPTP1 and *ESPTP2.
If the cable is disconnected from this connector, the loader immediately performs an emergency stop. When this connector is not used, install a dummy connector, instead of the cable, to enable signal processing.



3.7.5 Connecting the I/O Signals for Loader Control

The loader I/O board has I/O signals for controlling the loader main body.

3.7.5.1 Outline

DI = 6 points (general–purpose 24–V input)
DO = 8 points (general–purpose 24–V source output)
DI = 1 point (24–V input for emergency stop)

The six input signals and eight output signals are used to open and close the hand at the end of the loader arm as well as to control air blow and other operations. The emergency stop input signal is used to stop the loader in an emergency, for example, when loader overtravel is detected (by hardware) or if the hand fractures.

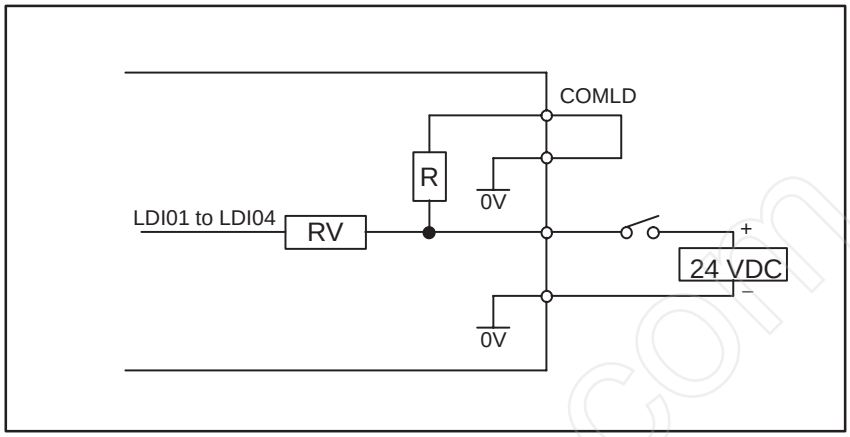
3.7.5.2 Connector

Connector pin layout on the loader I/O board side
CRM1 (MR50–pin, female)

1	LDI01			33	LDO01
2	LDI02	19	*LOT	34	LDO02
3	LDI03	20	LDI06	35	LDO03
4	LDI04	21	LDI05	36	LDO04
5	DCMLD	22	COMLD	37	LDO05
6	DCMLD	23	COMWF	38	LDO06
7		24		39	LDO07
8		25	DCMWF	40	LDO08
9	FDI01	26	DCMWF	41	FDO01
10	FDI02	27	0V	42	FDO02
11	FDI03	28	0V	43	FDO03
12	FDI04	29	0V	44	FDO04
13	FDI05	30	0V	45	FDO05
14	FDI06	31	+24V	46	FDO06
15	FDI07	32	+24V	47	FDO07
16	FDI08			48	FDO08
17	0V			49	+24V
18	0V			50	+24V

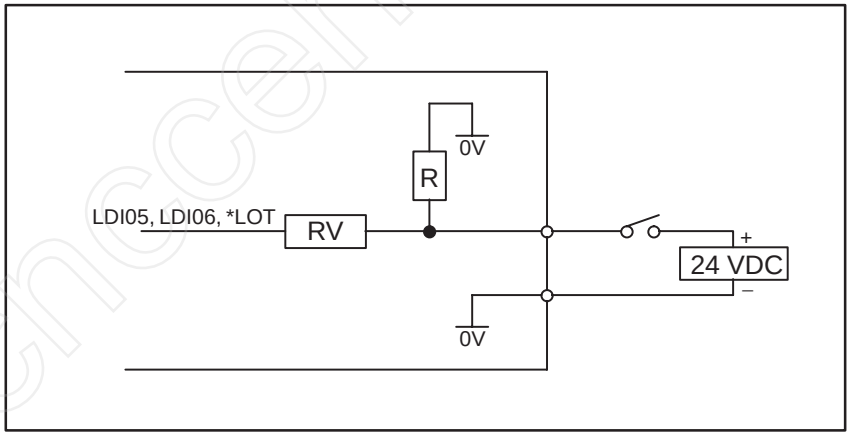
3.7.5.3 Connection

- LDI01 to LDI04



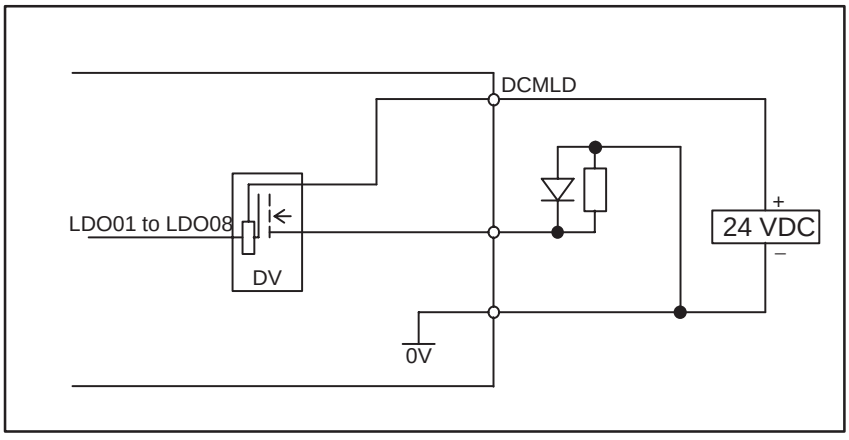
* COMLD is a common setting pin. When COMLD is connected to 0 V, LDI01 to LDI04 become common 24–V signals. When COMLD is connected to 24 V, LDI01 to LDI04 become common 0–V signals. The connection shown above sets LDI01 to LDI04 as common 24–V signals.

- LDI05, LDI06, *LOT (emergency stop input)



* The signals are tied to common 24 V.

- LDO01 to LDO08



* Connect the common voltage line of the source driver to DCMLD.

3.7.5.4 Signals

General–purpose input signals LDI01 to LDI06

Classification : 24–V input
The common voltage for LDI01 to LDI04 can be set to 24 V or 0 V. LDI05 and LDI06 are tied to common 24 V.

Function : The six input signals are used to interface the hand open/close confirmation signal for the hand at the end of the loader arm, as well as other signals. These input signals can be used for any purposes required by the loader mechanical unit.
When an incremental pulse coder is used and when zero point return is necessary, LDI01 to LDI04 are used as deceleration signals *DEC1 to *DEC4. The loader control CNC references the signals directly. When zero point return is not necessary, the PMC can use these signals for any purposes.

Common selection signal for general–purpose input signal COMLD

Classification : Common selection

Function : When COMLD is connected to 0 V, LDI01 to LDI04 become common 24–V input signals. When COMLD is connected to +24 V, LDI01 to LDI04 become common 0–V input signals. The signal polarity changes accordingly. When LDI01 to LDI04 are used as common 24–V signals, a closed contact makes the signals go to logical 1. When the signals are used as common 0–V signals, a closed contact makes the signals go logical 0.

General–purpose output signals LDO01 to LDO08

Classification : 24–V source output, 24–V/200–mA load

Function : These eight output signals are provided to open and close the hand at the end of the loader arm as well as to control air blow and other operations. The signals can be used as necessary.

Loader overtravel signal *LOT

Classification : 24–V input for emergency stop, tied to common 24 V

Function : The emergency stop input signal is provided to stop the loader in an emergency, for example, when loader overtravel is detected (by the hardware) or if the hand fractures. The signal is connected to contact B. In the normal state, 24 V should be supplied. As a DI signal, *LOT is held to 1 in the normal state.
When the signal goes off (open contact), the DI goes to 0, turning off the *EMG1 signal of connector CNPW. The externally mounted emergency stop control relay goes off, shutting down the servo MCC. This state continues while *LOT is off. The OTR signal is provided to temporarily release this state. See also Section 3.7.7, ”Connecting an Emergency Stop System.”

General–purpose input signals for workpiece feeder FDI01 to FDI08

Classification : 24–V input, set to common 24 V or 0 V
Function : These eight input signals are provided as an interface with a workpiece feeder. The signals can be used for any purpose related to the mechanical unit. When the skip function is used, however, FDI08 is used as a skip signal. When the skip function is not used, FDI08 can also be used for any purpose. The signals are connected in parallel to another connector CNWF.

Common selection signal for general–purpose input signals for workpiece feeder COMWF

Classification : Common selection
Function : When COMWF is connected to 0 V, FDI01 to FDI08 become common 24–V input signals. When COMWF is connected to +24 V, FDI01 to FDI08 become common 0–V input signals. The signal polarity changes accordingly. When FDI01 to FDI08 are used as common 24–V signals, a closed contact makes the signals go to logical 1. When the signals are used as common 0–V signals, a closed contact makes the signals go to logical 0.
This signal is connected in parallel to another connector CNWF.

General–purpose output signals for workpiece feeder FDO01 to FDO08

Classification : 24–V source output, 24–V/200–mA load
Function : These eight output signals are provided as an interface with a workpiece feeder. The signals can be used for any purpose related to the mechanical unit. The signals are connected in parallel to another connector CNWF.

3.7.6 Connecting a Workpiece Feeder

3.7.6.1 Outline

Eight input signals and eight output signals can be used to control a workpiece feeder.

DI = 8 points (general–purpose 24–V input)

DO = 8 points (general–purpose 24–V source output)

The signals are provided to make the workpiece feeder go forward or backward.

3.7.6.2 Connector

Connector pin layout on the loader I/O board side

CRM1 (MR50–pin, female) See Section 3.7.5.2.

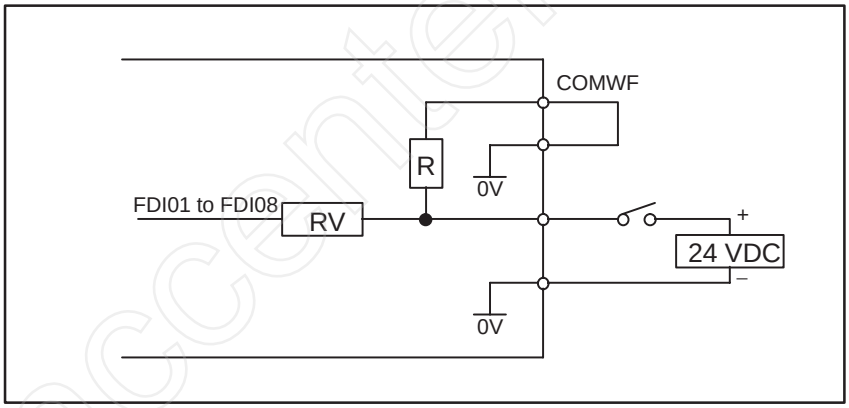
CNWF (MR20–pin, female)

(Both connectors have identical signal pins. Use a suitable connector.)

1	FDI01	8	FDI07	14	FDO01
2	FDI02	9	FDI08	15	FDO02
3	FDI03	10	COMWF	16	FDO03
4	FDI04	11	DCMWF	17	FDO04
5	FDI05	12	FDO06	18	FDO05
6	FDI06	13	0V	19	FDO07
7	+24V			20	FDO08

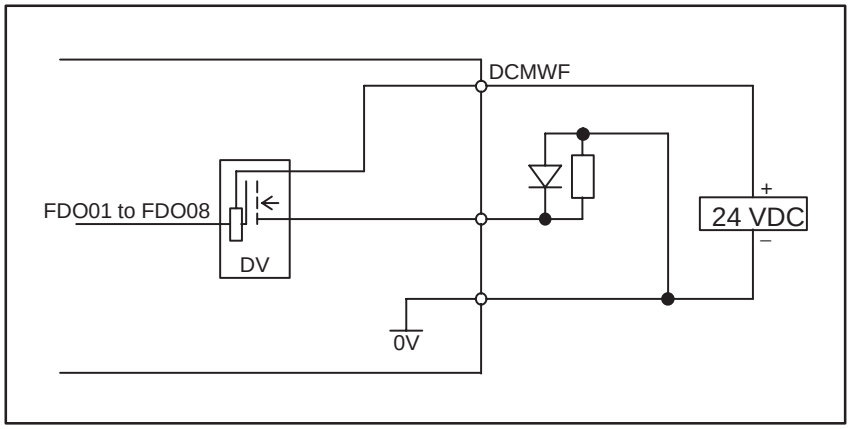
3.7.6.3 Connection

- FDI01 to FDI08



* COMWF is a common setting pin. When COMWF is connected to 0V, FDI01 to FDI08 become common 24–V signals. When COMWF is connected to 24 V, FDI01 to FDI08 become common 0–V signals. The connection shown above sets FDI01 to FDI08 as common 24–V signals.

- FDO01 to FDO08



* Connect the common voltage line of the source driver to DCMWF.

3.7.6.4 Signals

General–purpose input signals LDI01 to LDI06

Classification : 24–V input
The common voltage for LDI01 to LDI04 can be set to 24 V or 0 V. LDI05 and LDI06 are tied to common 24 V.

Function : The six input signals are provided to interface a hand open/close confirmation signal for the hand at the end of the loader arm, as well as other signals. These signals can be used for any purposes required by the loader mechanical unit.
When an incremental pulse coder is used and when zero point return is necessary, LDI01 to LDI04 are used as deceleration signals *DEC1 to *DEC4. The loader control CNC references the signals directly. When zero point return is not necessary, the PMC can use these signals for any purpose.

Common selection signal for general–purpose input signals COMLD

Classification : Common selection

Function : When COMLD is connected to 0 V, LDI01 to LDI04 become common 24–V input signals. When COMLD is connected to +24 V, LDI01 to LDI04 become common 0–V input signals. The signal polarity also changes accordingly. When LDI01 to LDI04 are used as common 24–V signals, a closed contact makes the signals go to logical 1. When the signals are used as common 0–V signals, a closed contact makes the signals go to logical 0.

General–purpose output signals LDO01 to LDO08

Classification : 24–V source output, 24–V/200–mA load

Function : These eight output signals are provided to open and close the hand at the end of the loader arm as well as to control air blow and other operations. The signals can be used as necessary.

Loader overtravel signal *LOT

Classification : 24–V input for emergency stop, tied to common 24 V

Function : The emergency stop input signal is provided to stop the loader in an emergency, for example, when loader overtravel is detected (by the hardware) or if the hand fractures. The signal is connected to contact B. In the normal state, 24 V should be supplied. As a DI signal, *LOT is held to 1 in the normal state.
When the signal goes off (open contact), the DI goes to 0, turning off the *EMG1 signal of connector CNPW. The externally mounted emergency stop control relay goes off, shutting down the servo MCC. This state continues while *LOT is off. The OTR signal is provided to temporarily release this state. See also Section 3.7.7, ”Connecting an Emergency Stop System.”

General–purpose input signals for workpiece feeder FDI01 to FDI08

Classification : 24–V input, set to common 24 V or 0 V

Function : These eight input signals are provided as an interface with a workpiece feeder. The signals can be used for any purpose related to the mechanical unit. When the skip function is used, however, FDI08 is used as a

skip signal. When the skip function is not used, FDI08 can also be used for any purpose. The signals are connected in parallel to another connector CNWF.

Common selection signal for general–purpose input signals for workpiece feeder COMWF

Classification : Common selection
Function : When COMWF is connected to 0 V, FDI01 to FDI08 become common 24–V input signals. When COMWF is connected to +24 V, FDI01 to FDI08 become common 0–V input signals. The signal polarity changes accordingly. When FDI01 to FDI08 are used as common 24–V signals, a closed contact makes the signals go to logical 1. When they are used as common 0–V signals, a closed contact makes the signals go to logical 0.
These signals are connected in parallel to another connector CNWF.

General–purpose output signals for workpiece feeder FDO01 to FDO08

Classification : 24–V source output, 24–V/200–mA load
Function : These eight output signals are provided as an interface with a workpiece feeder. The signals can be used for any purpose related to the mechanical unit. The signals are connected in parallel to another connector CNWF.

3.7.7 Connecting an Emergency Stop System

3.7.7.1 Outline

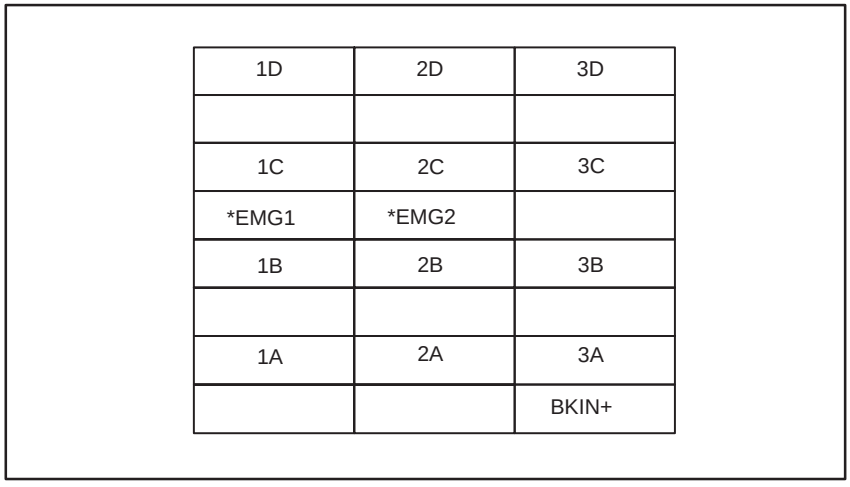
The emergency stop control circuit of the loader I/O board is based on the emergency stop control circuit on the loader control board of the Series 16/18–MODEL A/B/C.

For details of the emergency stop control circuit, see also Section 2.6.

3.7.7.2 Connector

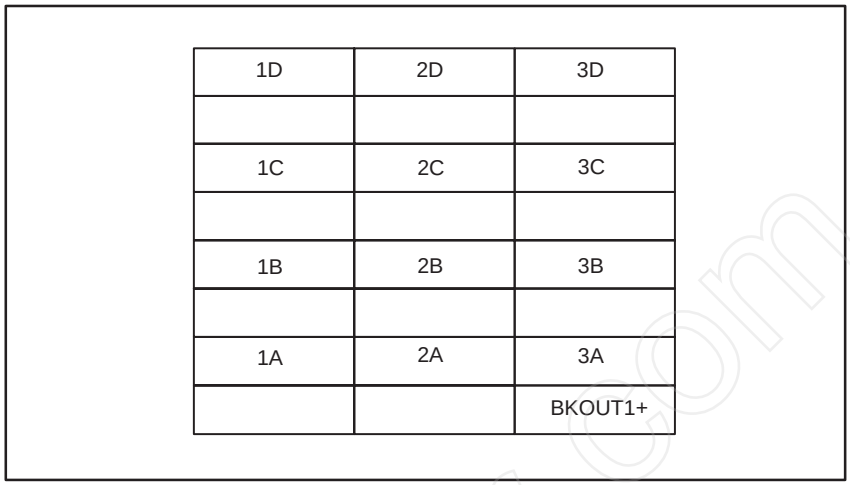
Connector pin layout on the loader I/O board side

- Emergency stop control circuit interface C
  NPW (AMP D–3400, 12 pins, male)



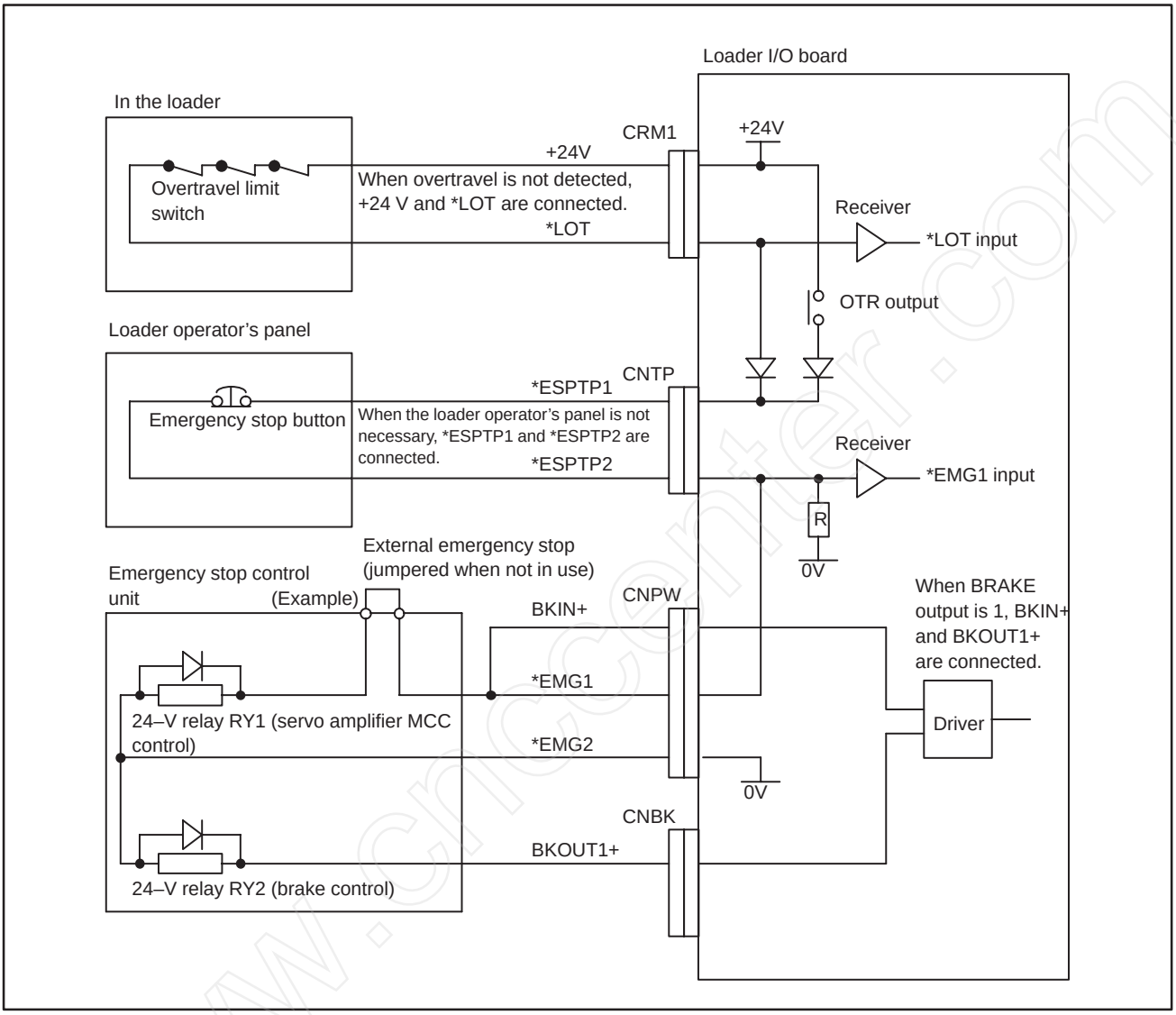
1D	2D	3D
1C	2C	3C
*EMG1	*EMG2	
1B	2B	3B
1A	2A	3A
		BKIN+

- Brake drive output interface
  CNBK (AMP D–3400, 12 pins, male)



3.7.7.3 Sample Connection of Emergency Stop System

The figure below shows a sample connection of an emergency stop system using the loader I/O board.



3.7.8 I/O Address Table

The table below indicates I/O addresses when this board is addressed X0 and Y0.

Input signals

Address	7	6	5	4	3	2	1	0
X0000	*EMG1	*LOT	LDI06	LDI05	LDI04	LDI03	LDI02	LDI01
X0001								
X0002	SKIP	FDI07	FDI06	FDI05	FDI04	FDI03	FDI02	FDI01
X0003								
X0004	TDI08	TDI07	TDI06	TDI05	TDI04	TDI03	TDI02	TDI01
X0005								

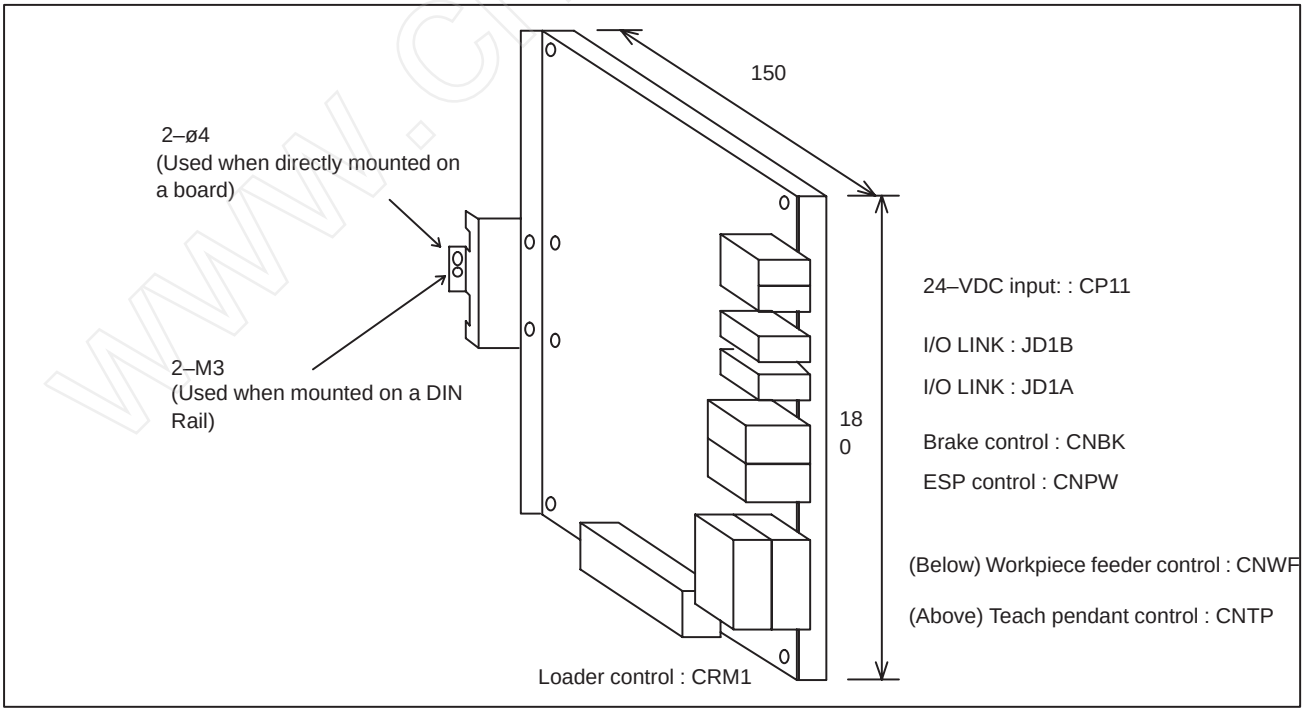
Output signals

Address	7	6	5	4	3	2	1	0
Y0000	LDO08	LDO07	LDO06	LDO05	LDO04	LDO03	LDO02	LDO01
Y0001	FDO08	FDO07	FDO06	FDO05	FDO04	FDO03	FDO02	FDO01
Y0002					TCOM4	TCOM3	TCOM2	TCOM1
Y0003	OTR		TDO06	TDO05	TDO04	TDO03	TDO02	TDO01
Y0004								BRAKE
Y0005								

3.7.9 Installation

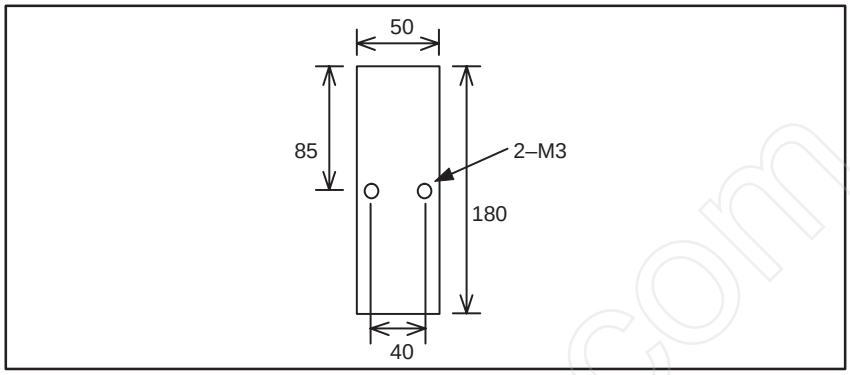
3.7.9.1 Installation

As shown below, an attachment for installation perpendicular to the board is provided. This attachment can be mounted on a DIN Rail or other flat board.



3.7.9.2 Installation space and mounting holes

The figure below shows the installation space and mounting holes for direct mounting on a board. For direct mounting on a board, the attached metal fixture for the DIN Rail is not used.



3.7.9.3 Mounting on a DIN rail

Use a DIN Rail that is 35 mm wide and 7.5 mm high.

Remove the metal fixture for the DIN Rail, together with the fixing screws, from the attachment. Hook the lower claw of the attachment on the DIN rail. Raise the attachment a little until the upper claw hooks onto the DIN Rail. Then, lower the attachment and check that the upper and lower claws hook onto the DIN rail correctly. Re–mount the DIN Rail metal fixture on the attachment and secure it with the screws.

3.7.10 Other Notes

- **Output signal alarm detection**

The source output driver used for the loader I/O board has functions for detecting load overcurrent and the temperature of the driver itself. When the load current increases excessively because of wire grounding or overheating of the driver, for example, the protection circuit of each driver (eight output points) functions and holds the output off until the cause is removed.

To determine which driver has detected the abnormal status, check the LED display on the loader I/O board. Once turned on, the LED display remains on until the power is turned off.

Signal name	Address	LED to be checked
LDO01–08	Y0.0–Y0.7	LED3
FDO01–08	Y1.0–Y1.7	LED2
TCOM1–4	Y2.0–Y2.3	LED1

* The table indicates addresses, assuming that the loader I/O board is addressed X0 and Y0.

- **Behavior of the output signal when a system alarm is issued**

When a system alarm is issued in the CNC using the loader I/O board or when an I/O link communication alarm is issued, all output signals on the loader I/O board, including brake drive output, are turned off. When the CNC or loader I/O board is turned off, all output signals are turned off, too.

4 OPERATION

4.1 MDI KEY OPERATION FOR LOADER CONTROL

4.1.1 Screen Switching

Switching between the NC screen and loader screen	
<SHIFT> + <HELP>	Each time this operation is performed, the display switches between the NC screen and loader screen. Note, however, that this operation is possible only when the DI signal LCBS (G251.1) on the NC is set to 0.

4.1.2 Power–on

Memory all–clear at power–on	
<DELETE> + <RESET>	Clears all the memory areas of the NC (both the main and sub sides when the dual NC is used) and the loader.
<CAN> + <2>	Clears all the memory areas of the sub side of the dual NC.
<CAN> + <5>	Clears all the memory areas of the loader.

Clearing parameters/offsets at power–on (parameters only for the loader)	
<RESET> + <1>	Clears the parameters/offsets for the NC (main side when the dual NC is used).
<RESET> + <2>	Clears the parameters/offsets for the sub side of the dual NC.
<RESET> + <5>	Clears the parameters for the loader.

Clearing programs at power–on	
<DELETE> + <1>	Clears the programs for the NC (main side when the dual NC is used).
<DELETE> + <2>	Clears the programs for the sub side of the dual NC.
<DELETE> + <5>	Clears the programs for the loader.

Clearing the RAM module of a PMC at power–on	
<X> + <0>	Clears the RAM module of the NC PMC.
<X> + <5>	Clears the RAM module of the loader PMC.

NOTE

These memory clear operations do not clear macro RAM. Instead, RAM is cleared when macro programs are transferred by the P–code loader. The loader control option for the Series 16/18–MODEL B/C and Series 21TB, Series 16*i*/18*i*/21*i* clears macro RAM unconditionally at power–on.

Resetting the software overtravel alarm at power–on	
<CAN> + <P>	Resets the software overtravel alarm on the NC.
<CAN> + <L>	Resets the software overtravel alarm on the loader.

Activating the P–code loader (For Series 16/18, Series 16*i*/18*i*/21*i*)	
<CAN> + <PROG>	Activates the P–code loader.

Starting the boot system for the Series 16/18–MODEL B/C and Series 21TB, Series 16*i*/18*i*/21*i*	
Rightmost two soft keys 	Starts the boot system for the Series 16/18–MODEL B/C and Series 21.

NOTE
The Series 21 does not support the P–code loader function.

4.2 STARTING THE LOADER CONTROL

4.2.1 Boot System for Series 16/18–MODEL B/C and Series 21–TB, Series 16*i*/18*i*/21*i*–MODEL A

The boot system load the CNC system software (flash RAM ⇒ DRAM), then start it so that software can be executed.

For details of the functions and operation of the boot system, refer to the corresponding CNC maintenance manual.

- FANUC Series 16/18/160/180–MODEL B MAINTENANCE MANUAL B–62445E
- FANUC Series 16/18/160/180–MODEL C MAINTENANCE MANUAL B–62755EN
- FANUC Series 16*i*/18*i*/160*i*/180*i*–MODEL A MAINTENANCE MANUAL B–63005EN
- FANUC Series 21/210 MAINTENANCE MANUAL B–62705EN
- FANUC Series 21*i*/210*i*–MODEL A MAINTENANCE MANUAL B–63085EN

● Memory card interface and flash ROM on the LCB board

(1) Memory card interface

The Series 16/18–B/C and Series 21–TB have a memory card interface on their LCB (loader control) boards. The boot system, however, uses only the interface on the main board.

The memory card interface on the LCB board is used only for a PMC ladder editing card. Insert the ladder editing card before power–up. For ladder editing, refer to ”FANUC PMC LADDER PROGRAMMING MANUAL (B–61863E).”

(2) Flash ROM

In the Series 16/18, the flash ROM on the LCB board should store just a P–CODE macro file for loader control. Store a ladder file in the flash ROM on the main board.

The table below lists the loader control files and their storage locations.

File type	Storage location
Loader PMC ladder program	Main flash ROM
Loader P–CODE macro file	LCB flash ROM

When using the Series 21, select a board on the Boot Slot Configuration screen. When handling (entering, deleting, etc) a main file, select MAIN (main board). When handling a loader file, select LCB (loader control board).

File type	Board selection
Main PMC ladder	MAIN
Main P–CODE macro file	MAIN
Loader PMC ladder	LCB
Loader P–CODE macro file	LCB

The Series 16*i*/18*i*/21*i* has no flash ROM on its LCB board. Both a loader PMC ladder program and P–CODE macro file are stored in the flash ROM on the motherboard.

● File names in flash memory

The boot system identifies a file in flash ROM by the first four characters of the file name. When a file is read from a memory card while a file having a file name starting with the same four characters exists, the existing file is deleted, then the new file is read into the flash memory. The table below lists the file names and corresponding contents. The file names are subject to change without notice.

- **Series 16/18–B/C, Series 16*i*/18*i*/21*i***

File name	Contents	File type
NC BASIC DG SERVO GRAPHIC NC□ OPTN PMC□****	Basic Servo Graphic Option PMC control software, etc.	System file
PCD **** PD1L **** CEX!**** PMC - **** PMC@****	P–CODE macro file/OMM (Series 16/18–B/C) P–CODE macro file/OMM (Series 16*i*/18*i*/21*i*) C executor Ladder software Loader ladder software	User file

A square (□) represents a single numerical character. An asterisk (*) represents a single alphabetical character.

For the name of the P–CODE macro file of the Series 16*i*/18*i*/21*i*, refer to ”FAPT MACRO COMPILER PROGRAMMING MANUAL (B–66102).”

- **Series 21–TB**

File name		Contents	File type
MAIN	NC BASIC DG SERVO NC1 OPTN PMCOBSC	Basic Servo Option PMC control	System file
	PCD **** PMC–RA	P–CODE macro file PMC ladder	User file
LCB	LC BASIC PMCBBSC	Basic (for loader control) PMC control (for loader control)	System file
	PCD **** PMC@RA	P–CODE macro file (for loader control) PMC ladder (for loader control)	User file

● Backup file name

An SRAM backup file on a memory card is given a name determined by the size of the SRAM mounted on the CNC. When the size of the SRAM is greater than or equal to 1 MB, multiple 512–KB backup files are created.

- **Series 16/18–B/C**

Number of files / SRAM size	1	2	3	4	5
256KB	SRAM256A.FDB				
0.5MB	SRAM0_5A.FDB				
1.0MB	SRAM1_0A.FDB	SRAM1_0B.FDB			
1.5MB	SRAM1_5A.FDB	SRAM1_5B.FDB	SRAM1_5C.FDB		
2.5MB	SRAM2_5A.FDB	SRAM2_5B.FDB	SRAM2_5C.FDB	SRAM2_5D.FDB	SRAM2_5E.FDB

- **Series 21–TB**

SRAM size		File name	Remarks
MAIN	256KB	SRAM256K. XXX	Backup of SRAM on the main board
	512KB	SRAM512K. XXX	
LCB	512KB	SRAM_LCB. XXX	Backup of SRAM on the LCB board

- **Series 16*i*/18*i*/21*i***

Number of files / SRAM size	1	2	3	4	5	6
256KB	SRAM256A. FDB					
0.5MB	SRAM0_5A. FDB					
1.0MB	SRAM1_0A. FDB	SRAM1_0B. FDB				
2.0MB	SRAM2_0A. FDB	SRAM2_0B. FDB	SRAM2_0C. FDB	SRAM2_0D. FDB		
3.0MB	SRAM3_0A. FDB	SRAM3_0B. FDB	SRAM3_0C. FDB	SRAM3_0D. FDB	SRAM3_0E. FDB	SRAM3_0F. FDB

The Series 21*i* has an SRAM of up to 0.5 MB.

When an LCB board or other non–main board is connected, the backup file of the SRAM on the board is given the following file extension.

- **Series 16/18–B/C**

Board type	Main	OPT2	OPT3	LCB
Extension	FDB	OP2	OP3	LCB

- **Series 16*i*/18*i*/21*i***

Board type	Main	PMC–RE	CAPII	LCB
Extension	FDB	PMC	CAP	LCB

4.2.2 Starting the NC and Loader Control

1	Turn on the power.
2	Enter the parameters and ladder programs for the NC. If bit 7 of parameter No. 8100 for the NC is set to 0 at this time, the NC cannot exit from reset processing. In this case, set the servo parameters for loader control correctly, then turn the power off then back on again. Then, the NC can exit from reset processing when the emergency stop is released on the loader. When bit 7 of parameter No. 8100 is set to 1, the NC can exit from the reset processing, regardless of the loader control parameters.
3	Switch to the loader control screen. If the DI signal LCBS (G251.1) is being processed by an NC ladder program, set the signal to 1 to switch to the loader control screen. If the DI signal LCBS (G251.1) is not being processed by an NC ladder program, press the <SHIFT> and <HELP> keys at the same time to switch to the loader control screen.
4	Set the parameters. (1) Parameter setting through the MDI i) Establish MDI mode or the emergency stop state. ii) Set PARAMETER WRITE on the setting screen to 1 (ENABLE). At this time, alarm P/S 100 is displayed. iii) Press the [SYSTEM] key to display the parameter screen. iv) Position the cursor to each required parameter, then set the parameter. v) Upon the completion of input for each parameter, set PARAMETER WRITE on the setting screen to 0. vi) If alarm P/S 000 is issued, turn the power off then back on again. (2) Parameter input through the RS–232C interface i) Establish EDIT mode or the emergency stop state. ii) Set PARAMETER WRITE on the setting screen to 1 (ENABLE). At this time, alarm P/S 100 is displayed. In EDIT mode, however, PARAMETER WRITE cannot be set to 1. So, establish the emergency stop state or MDI mode before attempting to set PARAMETER WRITE to 1. iii) Press the [SYSTEM] key to display the parameter screen. iv) To read the parameters through the RS–232C interface, press the [OPRT], [>], [READ], then [EXEC] soft keys. v) Upon the completion of parameter input, set PARAMETER WRITE on the setting screen to 0. vi) If alarm P/S 000 is issued, turn the power off then back on again.

5	Enter ladder programs. (1) When ladder RAM operation is performed with the loader for the Series 16/18–MODEL A ● Enter the ladder programs through the RS–232C interface, after first turning the power off then back on again. (2) When the loader for the Series 16/18–MODEL B/C and Series 21 is used ● Enter the ladder programs from the memory card through the RS–232C interface. Read the ladder programs after switching to the loader screen, in the same way as for parameter input. For details of the operation, refer to the descriptions of write, read, and check (I/O) for sequence programs and PMC parameter data in the ladder language programming manual.
6	When macro executor RAM operation is performed with the loader for the Series 16/18–MODEL A i) Insert the RAM module into the slot marked MACRO on the loader control board. ii) Hold down both the <CAN> and <PROG> keys, and turn on the power. iii) The P–code loader tool post selection screen appears. Press <5>. iv) After preparation for loading has been completed, press <1>. This sets the receive ready state. v) Send the macro programs from the P–G or personal computer. vi) After macro program transfer has been completed and a message displayed, press <1> to return to the menu screen of iii) above. vii) Press <0> to start the NC and loader. When macro executor operation is performed using the loader for the Series 16/18–MODEL B/C, Series 16*i*/18*i*/21*i* i) Hold down both the <CAN> and <PROG> keys and turn on the power. ii) The P–code loader tool post selection screen appears. Press <5>. iii) After preparation for loading has been completed, press <1>. This establishes the receive ready state. iv) Send the macro programs from the P–G or personal computer. v) After macro program transfer has been completed, press <1> to write to the flash ROM, or press <CAN> to abandon writing to the flash ROM. vi) After flash ROM write has been completed and a message displayed, press <1>. vii) The user can return to the tool post selection screen of ii) above by pressing <CAN> in v) or <1> in vi). viii) To start the NC and loader, press <0> on the tool post selection screen. When macro executor operation is performed using the loader for the Series 21TB For the Series 21TB, the memory card interface is used to load a P–code macro program. Load a P–code macro program from the memory card into flash memory, as explained in Subsec. 3.2.1. The Series 21 does not support the use of the RS–232C interface to load a P–CODE macro program.

NOTE
1 Before the macro executor can be used with the loader, the macro executor option must be selected for the loader. For RAM operation, the RS–232C option is required.
2 The RS–232C parameter, set for the NC (main side when the dual–system option is used), is used.

4.2.3 When Loader Control is Added

1	Hold down both the <CAN> and <5> keys, and turn on the power. All loader memory areas are cleared. (The NC memory is not affected.) At this time, the symptom described in 2 of Section 3.2.2 arises. To check that the NC starts, set bit 7 of parameter No. 8100 to 1, then turn the power off then back on.
2	The subsequent operations are the same as in 3 through 6 of Section 3.2.2.

[Explanation]

- Why memory must be cleared:
  When the memory power is not turned on, the states of the bits are undefined. If RAM is read in such a state, there is very high probability that a RAM parity alarm will be issued. (If an NC parity error occurs, an alarm between No. 910 and No. 919 is issued. If a loader parity error occurs, alarm No. 972 is issued.)
- When the macro executor RAM must be inserted into the loader control board (with the loader for the Series 16/18–MODEL A only)
  The RAM board for macro executor debugging is not cleared by turning on the power. So, a RAM parity error may occur if the RAM board is not cleared. However, macro RAM is cleared by activating the P–code loader. This means that the RAM board can be inserted at any time after the RAM is cleared at power–on and or at macro RAM clear using the P–code loader.

4.2.4 Special Parameters to be Set

For loader control, the following parameters must always be set as described below.

Bit 7 of parameter No. 8100

When bit 7 of parameter No. 8100 is set to 0, servo motor activation is simultaneously started for all axes after activation of all servo motors on the NC and loader sides has become possible. So, if the emergency stop state is set, or a servo alarm is issued on a loader control axis because of incorrect servo parameter setting, for example, the NC holds reset processing. That is, the NC cannot exit from reset processing until activation on the loader control side has become possible.
When bit 7 of parameter No. 8100 is set to 1, synchronous activation is not performed, activation instead being started independently. So, the NC need not hold reset processing.
So, when the loader is to be started after the NC has successfully started, set bit 7 of parameter No. 8100 to 1 for both the NC and loader. If this bit is set to 0, the NC does not exit from reset processing after power–on until the emergency stop state is released and provided no servo alarms are issued for any axis.
In cases where the NC and loader share a two–axis amplifier so that the NC uses one axis and the loader uses the other, however, always set this bit to 0.

Bit 3 of parameter No. 3003

Set bit 3 of parameter No. 3003 to 1. Otherwise, movement along any axis may not be possible.

Bit 4 of parameter No. 3402

Set bit 4 of parameter No. 3402 to 1. Otherwise, cutting feed may not be performed normally.

Bit 5 of parameter No. 3004

This bit is used to ignore hardware overtravel.
When the overtravel limit signals (G110, G112) are not used, and bit 5 of parameter No. 3004 is set to 1, overtravel alarms 506 and 507 are not issued.

Parameter No. 8710 (This parameter needs to be set only when version B251–01 of the Series 16/18–MODEL A loader control is being used.)

Specify 768 in this parameter.
If this parameter is not set, and version B251–01 is being used, alarm 972 may be issued when a large ladder program is executed.
This parameter need not be set when later versions are being used.

4.3 PROGRAMMING

4.3.1 G Codes

The table below lists the G codes that can be used with the loader control option. When the G code column and group column are divided into two, the left–hand column indicates the G codes for the T series, while the right–hand column indicates those for the M series.

G code		Group		Function
G00		01		Positioning (Rapid traverse)
G01				Linear interpolation (Cutting feed)
G02				Circular interpolation CW
G03				Circular interpolation CCW
G04		00		Dwell
G10				Data setting
G11				Parameter input mode cancel
G17		16	02	XpYp plane selection
G18				ZpXp plane selection
G19				YpZp plane selection
G20		06		Inch data input
G21				Metric data input
G22		09	04	Stored stroke limit function on
G23				Stored stroke limit function off
G27		00		Reference position return check
G28				Return to reference position
G30				2nd, 3rd, 4th reference position return
G31				Skip function
G50	G92			Coordinate system setting
G52				Local coordinate system setting
G53				Machine coordinate system selection
G54		14		Workpiece coordinate system 1 selection
G55				Workpiece coordinate system 2 selection
G56				Workpiece coordinate system 3 selection
G57				Workpiece coordinate system 4 selection
G58				Workpiece coordinate system 5 selection
G59				Workpiece coordinate system 6 selection
G65		00		Macro calling
G66		12		Macro modal calling
G67				Cancel of macro modal calling
	G90	03		Absolute input
	G91			Incremental input

4.4 LOADER CONTROL FUNCTIONS

4.4.1 Multipath Wait Function with M Code (T Series Only)

● Overview

1) Two–path wait function
When an M code is specified for the NC and loader control of the FANUC Series 16–TA, 16–TB, 18–TA, or 21–TB a two–path wait can be executed.

- When a waiting M code is specified in the programs for the NC and loader, either can wait for the other in the specified block.
- The M code must be specified in a single block as shown below:

M m ;

m: Waiting M code number

2) Three–path wait function (for the Series 16/18)
A system featuring a two–path (TT) NC and loader control can use a three–path wait function.
The range of three–path waiting M codes is specified in the main and loader parameters (parameters 8110 and 8111) in the same way as the range of two–path waiting M codes is specified.

- A wait pattern is specified after address P in the same block as the waiting M code. Address P is used to distinguish a three–path wait from a two–path wait.
- The M code must be specified in a single block, as shown below:

M m P p ;

m: Waiting M code number

p : Number specifying a wait pattern

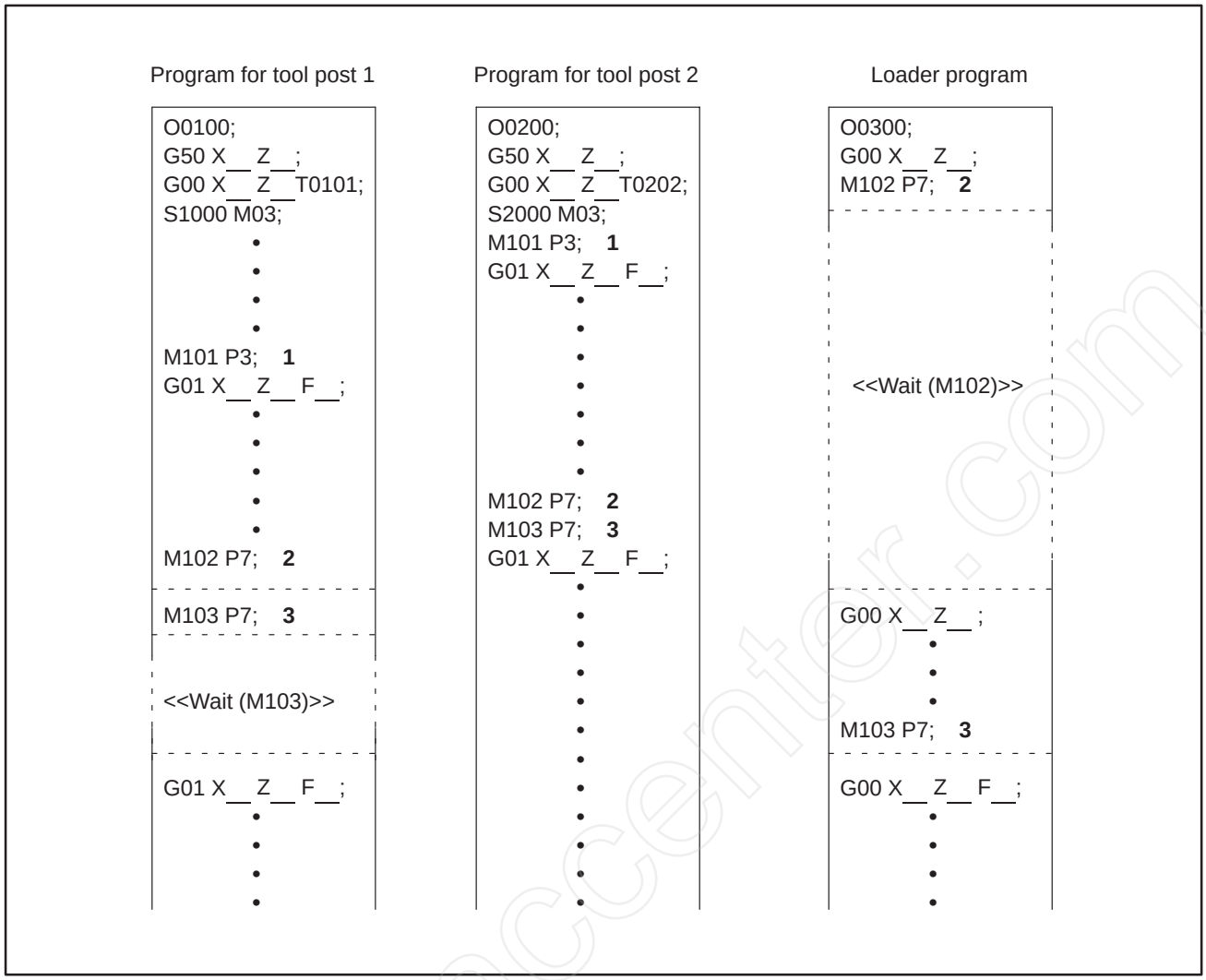
- Table 3.4.1 lists address–P values and their meanings:

Table 3.4.1

Address P	Wait pattern	Meaning			
		(Not used) Bits 7 to 3	Loader Bit 2	SUB Bit 1	MAIN Bit 0
P3	MAIN–SUB wait	00000	0	1	1
P5	MAIN–loader wait	00000	1	0	1
P6	SUB–loader wait	00000	1	1	0
P7	MAIN–SUB–loader wait	00000	1	1	1

Examples

When the wait ignore signal (G1063.7) of tool post 2 is set to 1 and M101 to M103 are specified as waiting M codes
Parameter setting : Parameter 8110 = 101
Parameter 8111 = 103



1 M101 P3; (wait between tool posts 1 and 2)
If the wait ignore signal of tool post 2 was set to 0, tool posts 1 and 2 would wait for each other. In this example, however, the wait ignore signal of tool post 2 is set to 1. When executing the waiting M code, tool posts 1 and 2 immediately assume that the wait has been completed and execute the next instruction.
Tool posts 1 and 2 do not wait for each other.

2 M102 P7; (Wait by tool post 1, tool post 2, and loader)
In this example, the loader waits until the processing being performed by tool posts 1 and 2 terminates.
Because the wait ignore signal of tool post 2 is set to 1, the loader waits until the processing of tool post 1 ends, then executes the next instruction.

3 M103 P7; (Wait by tool post 1, tool post 2, and loader)
In this example, tool posts 1 and 2 wait until the processing being performed by the loader terminates.
Because the wait ignore signal is set to 1, tool post 2 does not wait until the loader processing terminates, instead proceeding to the next step.
Tool post 1 waits for the loader.

● **Signals**

Two–path wait ignore signal

NOWT <G063, bit 1>

[Classification] Input signal

[Function] Specifies whether to execute a two–path wait with an M code.

[Operation] 0: A two–path wait with an M code is executed.
1: A two–path wait with an M code is not executed.

Three–path wait ignore signal

NMWT <G063, bit 7>

[Classification] Input signal

[Function] A three–path waiting M code can be ignored.

[Operation] 0: A three–path waiting M code is valid. The tool post or loader of another path will wait for the tool post or loader of this path.
1: A three–path waiting M code is invalid. When the waiting M code is executed, it is assumed that the wait has been completed. Therefore, the tool post or loader of another path will not wait for the tool post or loader of this path.

- When a program including a multipath waiting M code is executed automatically, this signal is used to stop a tool post or loader while automatic operation is being performed by the other tool post or loader. The wait ignore signal for the tool post or loader to be stopped must be set to 1.

Waiting signal (for both two–path and three–path waits)

WATO <F063, bit 6>

[Classification] Output signal

[Classification] Output signal

[Function] Reports that an M code of a tool post is being awaited.

[Output conditions] The signal is set to 0 when
- A tool post is not being awaited.

The signal is set to 1 while
- A tool post is being awaited, that is, for the period between a waiting M code being specified and the M code being specified on the other path.

1 Wait ignore signal

MAIN

	#7	#6	#5	#4	#3	#2	#1	#0
G0063	NMWT						NOWT	

SUB

	#7	#6	#5	#4	#3	#2	#1	#0
G1063	NMWT							

Loader control

	#7	#6	#5	#4	#3	#2	#1	#0
G0063	NMWT							

NOWT : Two–path wait ignore signal

NMWT : Three–path wait ignore signal

2 Waiting signal

MAIN, loader control

	#7	#6	#5	#4	#3	#2	#1	#0
F0063		WATO						

SUB

	#7	#6	#5	#4	#3	#2	#1	#0
F1063		WATO						

WATO : Waiting signal (for both two–path and three–path waits)

3 Miscellaneous function code signal

MAIN, loader control

	#7	#6	#5	#4	#3	#2	#1	#0
F0010	M07	M06	M05	M04	M03	M02	M01	M00
F0011	M15	M14	M13	M12	M11	M10	M9	M8
F0012	M23	M22	M21	M20	M19	M18	M17	M16
F0013	M31	M30	M29	M28	M27	M26	M25	M24

SUB

	#7	#6	#5	#4	#3	#2	#1	#0
F1010	M07	M06	M05	M04	M03	M02	M01	M00
F1011	M15	M14	M13	M12	M11	M10	M9	M8
F1012	M23	M22	M21	M20	M19	M18	M17	M16
F1013	M31	M30	M29	M28	M27	M26	M25	M24

M00 TO M31 : M code signal

- **Parameters**

	#7	#6	#5	#4	#3	#2	#1	#0
8101								MWB

[Data type] : Bit

MWB A waiting M code is:

0: Buffered.

1: Not buffered.

NOTE
An M code not to be buffered as specified in parameters 3411 to 3420 is not buffered, irrespective of the MWB setting.

8110	Waiting M code range (minimum value)

[Data type] : 2 words
[Valid data range]: 0 and 100 to 99999999

This parameter specifies the minimum value of the waiting M code.

The waiting M code range is specified using parameter 8110 (minimum value) and parameter 8111 (maximum value).

(parameter 8110) ≤ (waiting M code) ≤ (parameter 8111)

NOTE
A value of 0 indicates that the waiting M code is not used.

8111	Waiting M code range (maximum value)

[Data type] : 2 words
[Valid data range]: 0 and 100 to 99999999

This parameter specifies the maximum value of the waiting M code.

- **Alarms and messages**

No.	Message	Description
160	MISMATCH WAITING M–CODE	In a two–path wait (1) The NC and loader programs specify different M codes. In a three–path wait (1) The commands have identical P values but different M codes. (2) The commands have identical M codes but different P values. (3) Both two–path and three–path wait are simultaneously speci fied.
161	ILLEGAL P OF WAITING M–CODE	(1) The address P value is nega tive, 1, 2, 4, or a value greater than 8. (2) The specified P value conflicts with the system configuration.

An alarm causes a single–block stop to occur, causing the path to enter the automatic operation stop state. Meanwhile, the other path or paths stop immediately and enter the automatic operation stop state.

CAUTION

1 In a system featuring two–path NC (TT) and loader control, a two–path waiting M code functions as a waiting M code for tool posts 1 and 2.
If a waiting M code is included in a loader program, it is processed as a general M code.
2 The two–path waiting M code differs from other M codes in that the code signal and strobe signal are not output.
3 The three–path waiting M code differs from the two–path waiting M code in that the code signal is output. However, the strobe signal is not output and FIN processing is unnecessary.

NOTE

If the settings made for the CNC and loader are different, a correct wait cannot be performed. While one waits for an M code, the other processes the M code as a general M code.

4.4.2 Creating Programs In Teach In Mode

When the playback option is selected, the **TEACH IN JOG** mode and **TEACH IN HANDLE** mode are added. In these modes, a machine position along the X, Z, and Y axes obtained by manual operation is stored in memory as a program position to create a program.
The words other than X, Z, and Y, which include O, N, G, R, F, C, M, S, T, P, Q, and EOB, can be stored in memory in the same way as in **EDIT** mode.

Procedure for Creating Programs in TEACH IN Mode

The procedure described below can be used to store a machine position along the X, Z, and Y axes.

1 Select the **TEACH IN JOG** mode or **TEACH IN HANDLE** mode.

2 Move the tool to the desired position with jog or handle.

3 Press PROG key to display the program screen. Search for or register the number of a program to be edited and move the cursor to the position where the machine position along each axis is to be registered (inserted).

4 Key in address X .

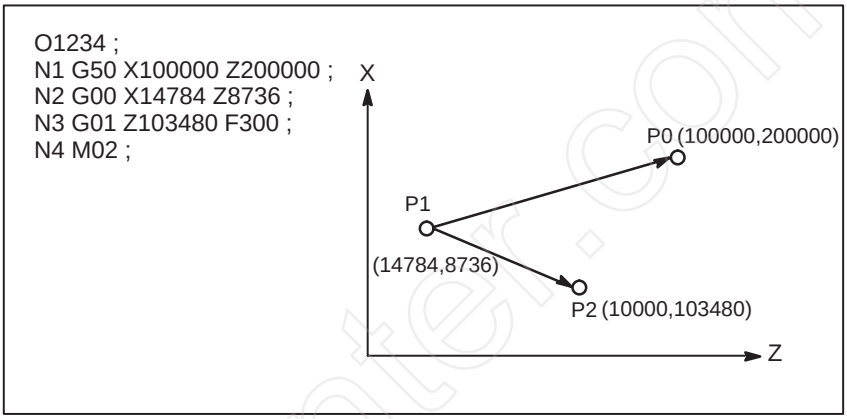
5 Press the INSERT key. Then a machine position along the X axis is stored in memory.

(Example) X10.521 Absolute position (for mm input)
X10521 Data stored in memory

6 Similarly, key in [Z], then press the [INSERT] key. Then a machine position along the Z axis is stored in memory. Further, key in [Y], then press the [INSERT] key. Then a machine position along the Y axis is stored in memory.

All coordinates stored using this method are absolute coordinates.

Examples



1 Set the setting data SEQUENCE NO. to 1 (on). (The incremental value parameter (No. 3212) is assumed to be “1”.)

2 Select the **TEACH IN HANDLE** mode.

3 Make positioning at position P0 by the manual pulse generator.

4 Select the program screen.

5 Enter program number O1234 as follows:

[O] [1] [2] [3] [4] [INSERT]

This operation registers program number O1234 in memory. Next, press the following keys:

[EOB] [INSERT]

An EOB (;) is entered after program number O1234. Because no number is specified after N, sequence numbers are automatically inserted for N0 and the first block (N1) is registered in memory.

6 Enter the P0 machine position for data of the first block as follows:

[G] [5] [0] [INSERT] [X] [INSERT] [Z] [INSERT] [EOB] [INSERT]

This operation registers G50 X100000 Z200000 ; in memory. The automatic sequence number insertion function registers N2 of the second block in memory.

7 Position the tool at P1 with the manual pulse generator.

8 Enter the P1 machine position for data of the second block as follows:

[G] [0] [0] [INSERT] [X] [INSERT] [Z] [INSERT] [EOB] [INSERT]

This operation registers G00 X14784 Z8736; in memory. The automatic sequence number insertion function registers N3 of the third block in memory.

9 Position the tool at P2 with the manual pulse generator.

10 Enter the P2 machine position for data of the third block as follows:

[G] [0] [1] [INSERT] [Z] [INSERT] [F] [3] [0] [0]
[INSERT] [EOB] [INSERT]

This operation registers G01 Z103480 F300; in memory.
The automatic sequence number insertion function registers N4 of the fourth block in memory.

11 Register M02; in memory as follows:

[M] [0] [2] [INSERT] [EOB] [INSERT]

N5 indicating the fifth block is stored in memory using the automatic sequence number insertion function. Press the [DELETE] key to delete it.

This completes the registration of the sample program.

Explanations

- **Checking contents of the memory**

The contents of memory can be checked in the **TEACH IN** mode by using the same procedure as in **EDIT** mode.

```
PROGRAM                              O1234  N00004

   (RELATIVE)          (ABSOLUTE)
   U     –85.216       X     14.784
   W     –191.264      Z      8.736


   O1234 ;
   N1 G50 X100000 Y0 Z20000 ;
   N2 G00 X14784 Z8736 ;
   N3 G01 Z103480 F300 ;
   N4 M02 ;
   %

>_
 THND     ****  ***  ***                  14 : 17 : 27
(PRGRM) ( LIB ) (      ) (      ) ( (OPRT) )
```

- **Registering a position with compensation**

When a value is keyed in after keying in address [X], [Z], or [Y], then the [INSERT] key is pressed, the value keyed in for a machine position is added for registration. This operation is useful to correct a machine position by key–in operation.

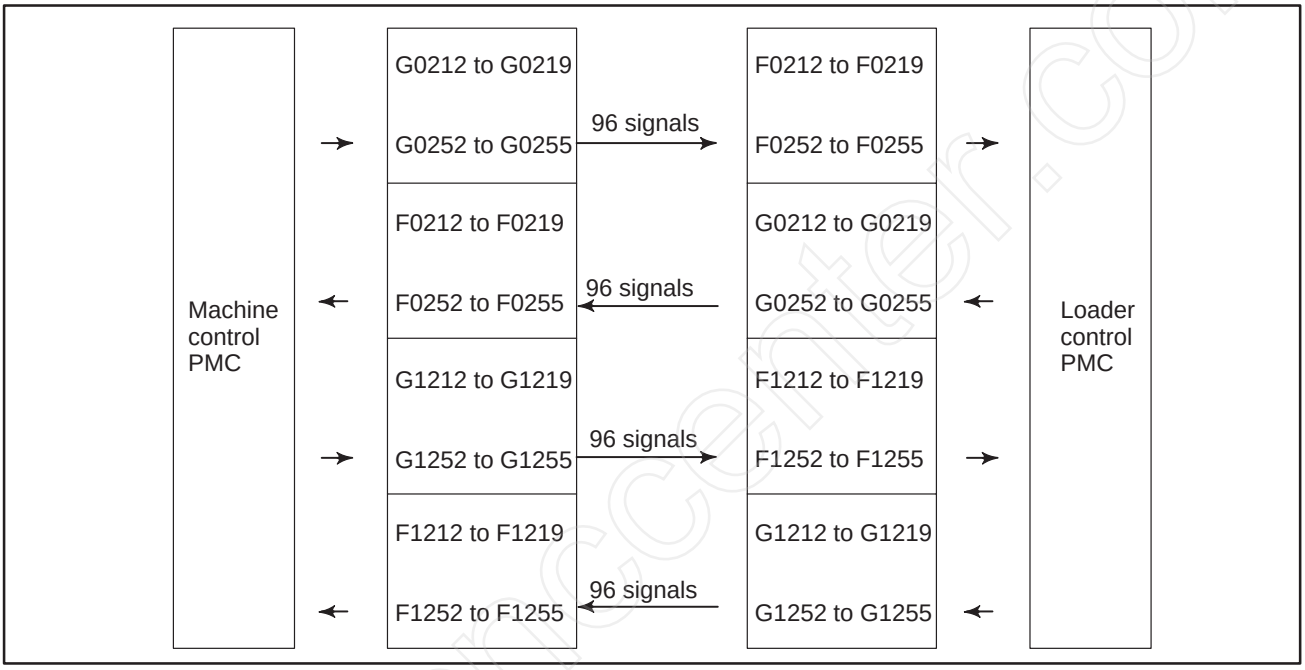
- **Registering commands other than position commands**

Commands to be entered before and after a machine position must be entered before and after the machine position is registered, by using the same operation as program editing in **EDIT** mode.

4.4.3 Loader–NC Communication Signals

- **Overview**

The loader control PMC and machine control PMC communicate via 96 or 192 signals.
An F address signal of the loader control PMC informs the contents of the corresponding G address signal of the machine control PMC.
An F address signal of the machine control PMC indicates the contents of the corresponding G address signal of the loader control PMC.



- **Signals**

Loader–NC communication signals
<F0212 to F0219, F0252 to F0255, F1212 to F1219, F1252 to F1255>

[Classification] Output signal

[Function] Reports the contents of the corresponding G address signal of the other PMC.

[Output conditions]

A bit is set to 0 when
- The corresponding bit of the G address of the other PMC is 0.

A bit is set to 1 when
- The corresponding bit of the G address of the other PMC is 1.

(Example) When bit 0 in G212 of the NC (machine) PMC is set to 1, bit 0 in F212 of the loader PMC is also set to 1.

- **Parameters**

No.	Data #7	#6	#5	#4	#3	#2	#1	#0
8102								S19

[Data type] : Bit

S19 The loader and NC use:

0 : 96 communication signals (G/F0212 to G/F0219 and G/F0252 to G/F0255).
1 : 192 communication signals.

NOTE
1 For this parameter setting to take effect, the power must be turned off then back on.
2 Only the loader supports this parameter.

4.4.4 Loader Control Selection Signal

- **Overview**

When the loader control function is provided, a loader control selection signal is added to the standard CNC–PMC interface. The loader control selection signal is similar to the HEAD signal of the 16–TTA or 18–TTA. The signal switches the object of the CRT display or MDI operation between the loader and NC.

- **Explanation**

Loader control selection signal (Only the NC (machine) supports this signal.)

LCBS
<G0251, bit 1>

[Classification] Input signal
[Function] Switches the object of CRT display or MDI operation between the loader and NC.
[Operation] 0 : NC (machine) is subjected to the CRT display or MDI operation.
1 : Loader control is subjected to the CRT display or MDI operation.

No.	#7	#6	#5	#4	#3	#2	#1	#0
G251							LCBS	

- **Parameter**

This function has no related parameters.

- **Alarm and message**

This function has no related alarms.

NOTE
1 When LCBS is set to 1, the object of CRT display or MDI operation can be switched to the loader or NC by holding down <SHIFT> on the MDI panel and pressing <HELP>.
2 Only the NC (machine) PMC supports the loader control selection signal (LCBS).

5 MAINTENANCE

5.1 LOADER CONTROL BOARD LED DISPLAY

5.1.1 LED Display Transition at Power–up

LED display (□ : OFF, ■: ON, The STATUS LEDs are green. The ALARM LEDs are red.)

No	LED display	NC status
1	STATUS □□□□	Power OFF
2	STATUS ■■■■	Startup status immediately after power is turned or CPU is not running
3	STATUS □■■■	Initializing RAM
4	STATUS ■□■■	Software ID has been set, initialization of keys, ALL CLR
5	STATUS □□■■	Waiting for software initialization 1
6	STATUS ■■□■	Waiting for software initialization 2, initializing CMOS
7	STATUS □■□■	Initializing position coder
8	STATUS □■■□	Waiting for digital servo system start up
9	STATUS ■□□□	Startup has been completed and the system is now in normal operation mode

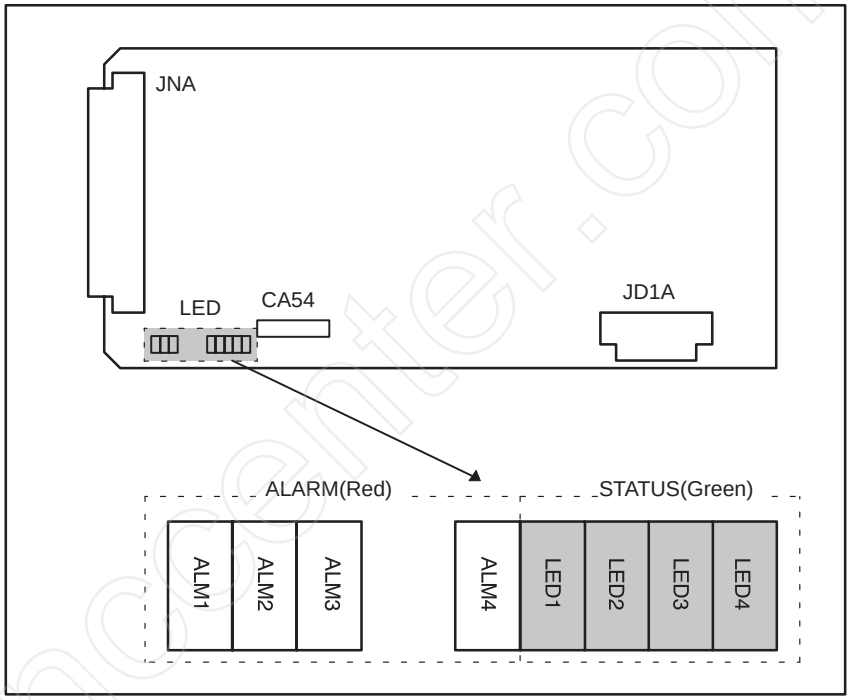
5.1.2 LED Display When an Error Occurs

LED display (□ : OFF, ■: ON, The STATUS LEDs are green. The ALARM LEDs are red.)

No	LED display	NC status
1	STATUS □■□□ ALARM ■□□	Parity error of loader control occured
2	STATUS □■□□ ALARM □□■	Servo alarm of loader control occured
3	STATUS □■□□ ALARM □□□	Other than parity or servo alarms occured

5.2 LED DISPLAY ON THE LOADER CONTROL BOARD OF THE SERIES 16*i*/18*i*/21*i*

5.2.1 Position of LEDs



5.2.2 LED Display Transition at Power–Up

No.	LED display	Description
1	STATUS □□□□	Power–off status
2	STATUS ■■■■	Immediately after power–up
3	STATUS ■■■□	RAM initialized
4	STATUS ■■□■	Software ID set, keys initialized
5	STATUS ■■□□	Waiting for completion of software initialization 1
6	STATUS ■□■■	Waiting for completion of software initialization 2
7	STATUS ■□■□	Position coder initialized, etc.
8	STATUS □■■□	Waiting for digital servo initialization
9	STATUS □□□■	Initialization completed (steady state)

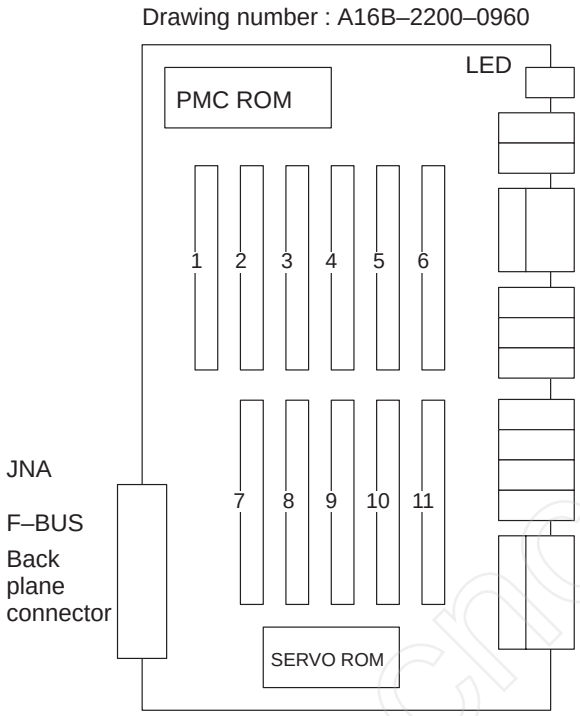
■ : On □ : Off

5.2.3 LED Display When an Error Occurs

LED	Description
ALM1	SRAM parity error
ALM2	Servo alarm
ALM3	Other alarm
ALM4	

5.3 PC BOARD CONFIGURATION

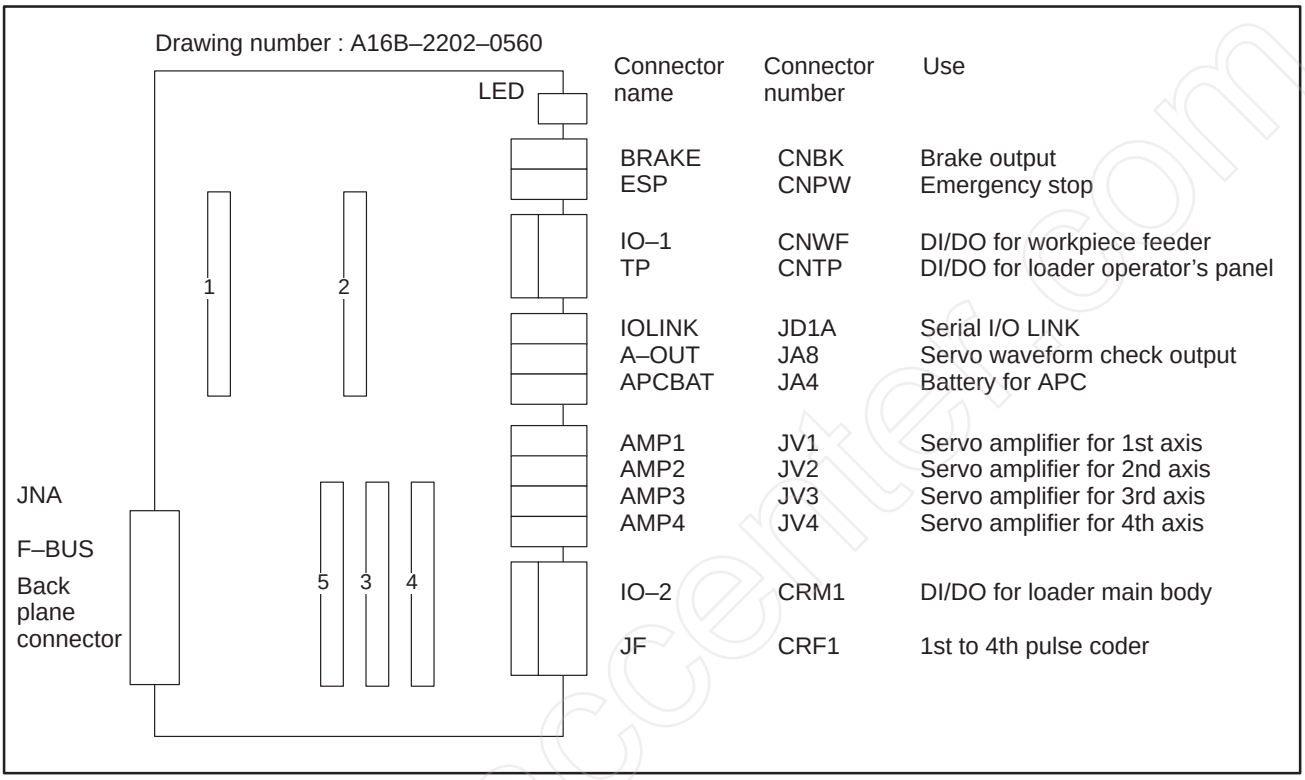
5.3.1 Series 16/18–MODEL A Loader Control Board



Connector name	Connector number	Use
BRAKE	CNBK	Brake output
ESP	CNPW	Emergency stop
IO–1	CNWF	DI/DO for workpiece feeder
TP	CNTP	DI/DO for loader operator's panel
IOLINK	JD1A	Serial I/O LINK
A–OUT	JA8	Servo waveform check output
APCBAT	JA4	Battery for APC
AMP1	JV1	Servo amplifier for 1st axis
AMP2	JV2	Servo amplifier for 2nd axis
AMP3	JV3	Servo amplifier for 3rd axis
AMP4	JV4	Servo amplifier for 4th axis
IO–2	CRM1	DI/DO for loader main body
JF	CRF1	1st to 4th pulse coder

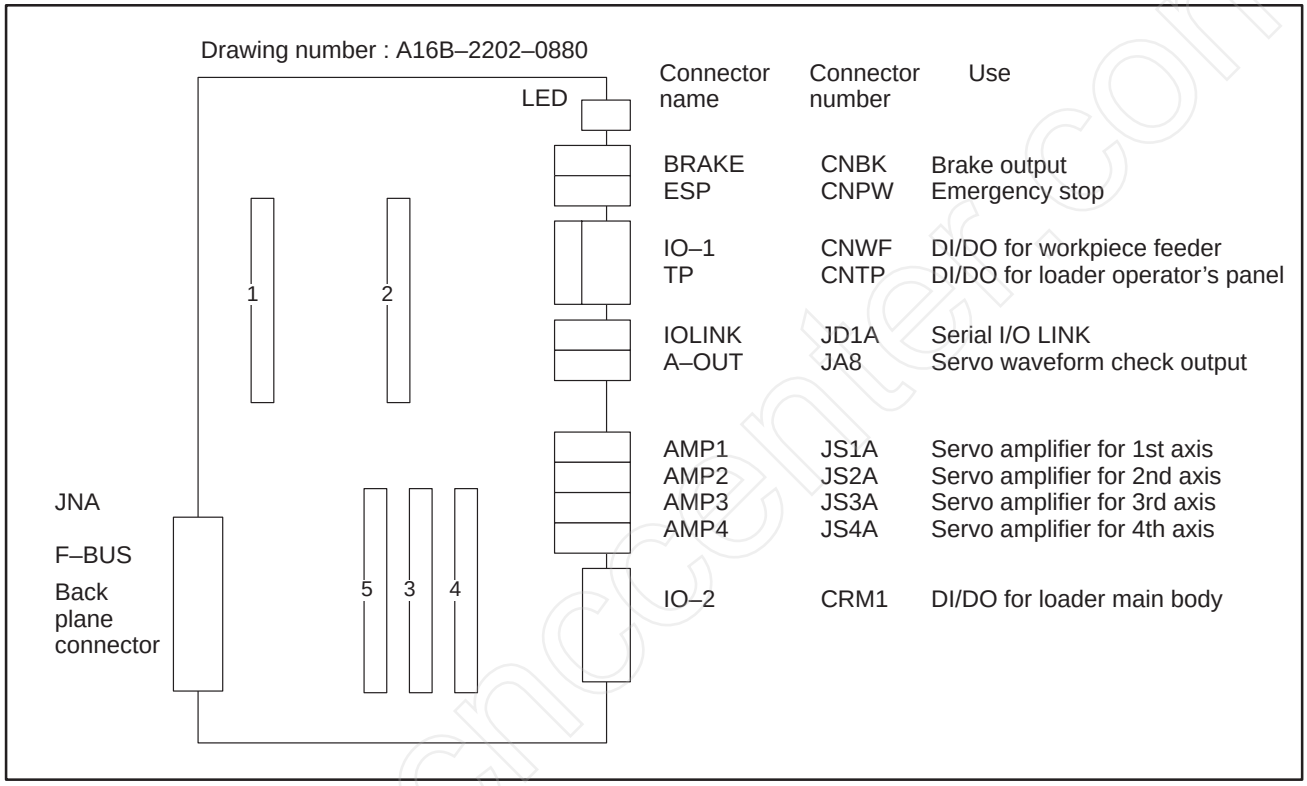
No	Name	Code	Function
1	ROM module	A20B–2900–0290 to 0293	ROM for macro
2	ROM module	A20B–2900–0290 to 0292	ROM for loader control system
3	SRAM module	A20B–2900–0530	RAM for PMC–RA1 debug
4	SRAM module	A20B–2900–0530, –0531 A20B–2900–0540, –0541	Part program strage and RAM for parameter
5	PMC control module	A20B–2900–0142, –0143	PMC arithmetical control
6	CPU module	A20B–2900–0930	CPU and peripheral circuit
7	System control module	A20B–2900–0108	Clear, backup control, etc
8	Servo control module	A20B–2901–0340	3rd, 4th axis digital servo control
9	Servo control module	A20B–2901–0340	1st, 2nd axis digital servo control
10	Servo interface module	A20B–2901–0380	3rd, 4th axis servo interface
11	Servo interface module	A20B–2901–0380	1st, 2nd axis servo interface

5.3.2 Series 16/18–MODEL B Loader Control Board Based on the Main A Specification



No	Name	Code	Function
1	FROM module	A20B–2902–0082	FROM for macro
2	DRAM module	A20B–2901–0940 to 0942	DRAM for system
3	Servo control module	A20B–2902–0060 to 0061	3rd, 4th axis digital servo control
4	Servo control module	A20B–2902–0060 to 0061	1st, 2nd axis digital servo control
5	PMC module	A20B–2900–0142 to 0143	PMC arithmetic control

5.3.3 Series 16/18–MODEL B Loader Control Board Based on the Main B Specification and Series 21 Loader Control Board



● For the main B specification the Series 16/18–MODEL B

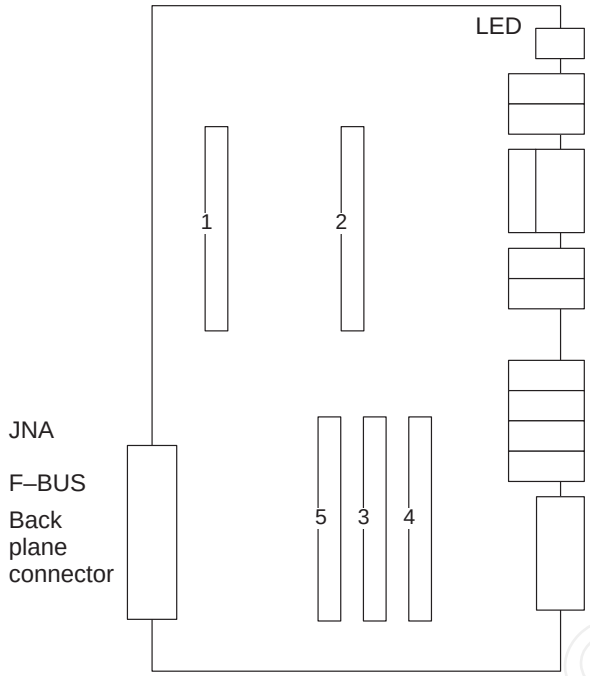
No	Name	Code	Function
1	FROM module	A20B–2902–0082	FROM for macro
2	DRAM module	A20B–2901–0940 to 0942	DRAM for system
3	Servo control module	A20B–2902–0060 to 0061	3rd, 4th axis digital servo control
4	Servo control module	A20B–2902–0060 to 0061	1st, 2nd axis digital servo control
5	PMC module	A20B–2900–0142 to 0143	PMC arithmetic control

● For the Series 21

No	Name	Code	Function
1	FROM module		Not used for the Series 21.
2	DRAM module	A20B–2901–0942	DRAM for system
3	Servo control module	A20B–2902–0290	3rd, 4th axis digital servo control
4	Servo control module	A20B–2901–0290	1st, 2nd axis digital servo control
5	PMC module	A20B–2900–0142 to 0143	PMC arithmetic control

5.3.4
Series 16/18–MODEL C
Loader Control Board

Drawing number : A16B–2203–0080



Connector name	Connector number	Use
BRAKE	CNBK	Brake output
ESP	CNPW	Emergency stop
IO–1	CNWF	DI/DO for workpiece feeder
TP	CNTP	DI/DO for loader operator's panel
IOLINK	JD1A	Serial I/O LINK
A–OUT	JA8	Servo waveform check output
AMP1	JS1A	Servo amplifier for 1st axis
AMP2	JS2A	Servo amplifier for 2nd axis
AMP3	JS3A	Servo amplifier for 3rd axis
AMP4	JS4A	Servo amplifier for 4th axis
IO–2	CRM1	DI/DO for loader main body

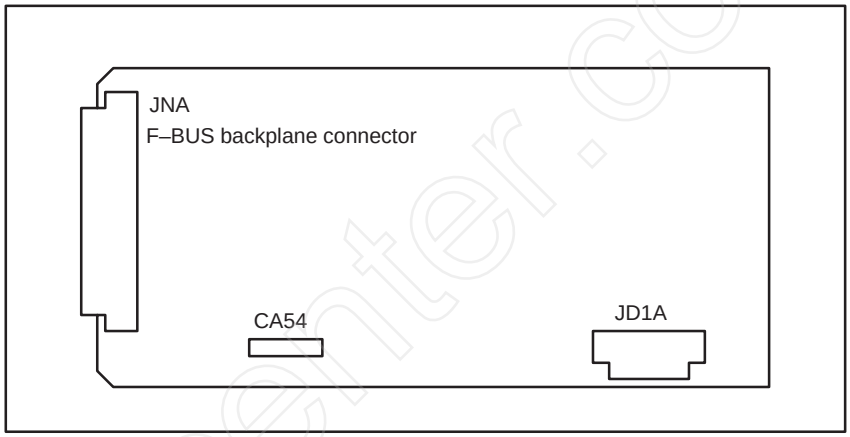
No	Name	Code	Function
1	FROM module	A20B–2902–0082	FROM for macro
2	DRAM module	A20B–2901–0940 to 0942	DRAM for system
3	Servo control module	A20B–2902–0070, A20B–2902–0061	3rd, 4th axis digital servo control
4	Servo control module	A20B–2902–0070, A20B–2902–0061	1st, 2nd axis digital servo control
5	PMC module	A20B–2900–0142 to 0143	PMC arithmetic control

5.4 CONFIGURATION OF LOADER CONTROL BOARD OF THE SERIES 16*i*/18*i*/21*i*

- **Code**

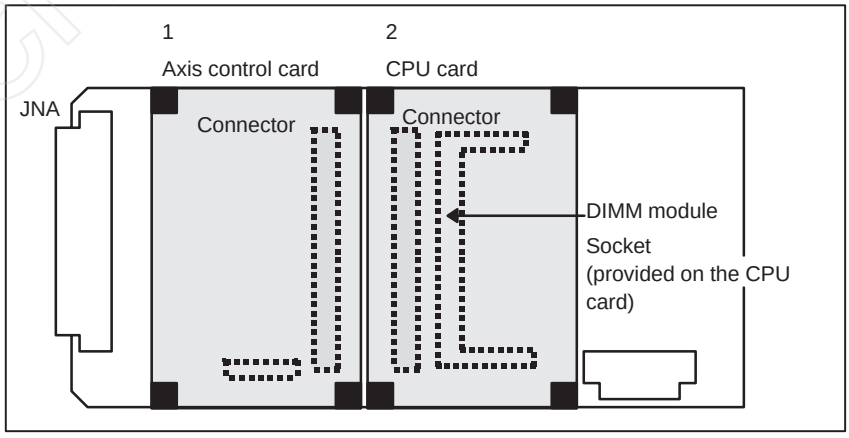
Name	Code
Loader control board	A20B–8100–0190

- **Connector location**



Connector No.	Use
CA54	Servo check
JD1A	I/O link

- **Card location**



No.	Name	Code	Function	Remarks
1	Axis control card	A20B–3300–0030	Axis control	Four axes
		A20B–3300–0031		Two axes
2	CPU card	A20B–3300–0070	CNC control	486DX2

APPENDIX

A PARAMETERS

A.1 PARAMETERS CLASSIFIED ACCORDING TO FUNCTIONS

This section lists parameters classified according to functions.

For details of each parameter, refer to the following CNC parameter manuals :

FANUC Series 16/18
PARAMETER MANUAL (B-61810E)

FANUC Series 16/18/160/180–MODEL B
PARAMETER MANUAL (B-62450E)

FANUC Series 16/18/160/180–MODEL C
PARAMETER MANUAL (B-62760EN)

FANUC Series 21/210
PARAMETER MANUAL (B-62710EN)

FANUC Series 21*i*/210*i*–MODEL A
PARAMETER MANUAL (B-63090EN)

1. Parameters related to the reader/punch interface (RS–232C)
2. Parameters related to program editing
3. Parameter related to external data input/output
4. Parameters related to controlled axes
5. Parameters related to the increment system
6. Parameters related to the coordinate system
7. Parameters related to rotation axes
8. Parameters related to return to the reference position
9. Parameters related to manual operation (jog)
10. Parameter related to cutting feed
11. Parameters related to rapid traverse
12. Parameters related to dry run
13. Parameters related to acceleration/deceleration
14. Parameters related to PMC axis control
15. Parameters related to manual handle feed
16. Parameters related to backlash
17. Parameters related to in–position check
18. Parameters related to interlock
19. Parameters related to stroke limit
20. Parameters related to the servo system
21. Parameters related to the absolute pulse coder
22. Parameters related to excessive errors
23. Parameters related to the CRT/MDI
24. Parameters related to display
25. Parameters related to DI/DO signals
26. Parameters related to clear and reset
27. Parameters related to miscellaneous functions
28. Parameter related to skip
29. Parameters related to macros
30. Parameters related to the position switch
31. Parameter related to DI/DO on the loader control board
32. Parameters related to multipath control

Parameters related to the reader/punch interface (RS–232–C)

1) Parameters for all channels

Parameter 0000, bit 0 :

Selects the specifications for TV check.

Parameter 0000, bit 1 :

Selects the specifications for data output in ISO code.

Parameter 0020 :

Selects an I/O channel.

Parameter 0100, bit 1 :

Selects the specifications for character counting for TV check in the comment section.

Parameter 0100, bit 3 :

Selects the specifications for EOB output in ISO code.

Parameter 0100, bit 7 :

Selects specifications such that an alarm is raised upon finding a null character while reading EIA codes.

2) Parameters related to channel 0

Parameter 0101, bit 0 :

Selects the length of the stop bit.

Parameter 0101, bit 3 :

Selects the specifications for data input in ASCII code.

Parameter 0101, bit 7 :

Selects specifications such that no feed code is output either before or after data.

Parameter 0102 :

Code number of an I/O device

Parameter 0103 :

Baud rate

3) Parameters related to channel 1

Parameter 0111, bit 0 :

Selects the length of the stop bit.

Parameter 0111, bit 3 :

Selects the specifications for data input in ASCII code.

Parameter 0111, bit 7 :

Selects specifications such that no feed code is output either before or after data.

Parameter 0112 :

Code number of an I/O device

Parameter 0113 :

Baud rate

4) Parameters related to program registration

Parameter 3201, bit 1 :

Selects specifications such that only a single program is registered on the reader/punch interface.

Parameter 3201, bit 2 :

Selects specifications such that a program having the same number as a registered program can be registered. (The already registered program is deleted.)

Parameter 3201, bit 6 :

Selects specifications such that M02, M30, or M99 is not regarded as the end of program registration.

Parameters related to program editing

1) Automatically inserting a sequence number

Parameter 0000, bit 5 :

Selects the function to automatically insert a sequence number.

Parameter 3216 :

Sequence number increment applied when a number is automatically inserted

2) Prohibiting program editing

Parameter 3202, bit 0 :

Selects specifications such that the editing of programs 8000 to 8999 is inhibited.

Parameter 3202, bit 4 :

Selects specifications such that the editing of programs 9000 to 9999 is inhibited.

Parameter 3202, bit 6 :

Enables protected program number search.

3) Others

Parameter 3401, bit 0 :

Selects specifications such that an address value input without a decimal point is assumed to be in units of mm, inch, or sec. (calculator–type decimal point input)

Parameter related to external data input/output

Parameter 6300, bit 4:

Enables external program number search.

Parameters related to controlled axes

Parameter 1010 :

Number of controlled CNC axes

Parameter 1020 :

Program axis name for each axis

Parameter 3131 :

Subscript for each axis name

Parameter 1022 :

Specifies the relationship between each axis and the basic coordinate system.

Parameter 1023 :

Servo axis number for each axis

Parameters related to the increment system

Parameter 0000, bit 2 :

Selects specifications such that values are input in inches.

Parameter 1001, bit 0 :

Selects specifications such that the least command increment for a linear axis is specified in inches.

Parameters related to the coordinate system

Parameter 3104, bit 0 :

Selects specifications such that machine positions are displayed according to the input system.

Parameter 3104, bit 3 :

Selects specifications such that the relative position display is preset by the coordinate system setting (G50).

Parameter 3290, bit 3 :

Inhibits the input of a coordinate system shift using the MDI keys.

Parameters related to rotation axes

Parameter 1006, bit 0 :

Selects a rotation axis.

Parameter 1008, bit 0 :

Selects the rotation axis roll–over function.

Parameter 1008, bit 1 :

Direction of rotation for an absolute command

Parameter 1008, bit 2 :

Selects specifications such that relative coordinates that do not correspond to the amount of travel for a single rotation are rounded.

Parameter 1260 :

Amount of travel corresponding to a single rotation of the rotation axis (when bit 0 of parameter 1008 is set to 1)

Parameters related to return to the reference position

1) Parameters related to a manual reference position return

Parameter 1002, bit 1 :

Selects the dogless reference position return function.

Parameter 1005, bit 1 :

Selects an axis of the dogless reference position return function.

Parameter 1006, bit 5 :

Direction of reference position return

Parameter 1240 :

Machine coordinates of first reference position

Parameter 1401, bit 0 :

Selects whether manual rapid traverse can be executed before the completion of a reference position return.

Parameter 1425 :

FL velocity during reference position return

Parameter 1836 :

Servo error required to establish a one–rotation signal during reference position return

Parameter 3003, bit 5 :

Selects specifications such that deceleration occurs when signals *DEC1 to *DEC4 are set to 1.

2) Parameters related to high–speed reference position return (third or fourth reference position return is an option.)

Parameter 1240 :

Machine coordinates of the first reference position

Parameter 1241 :

Machine coordinates of the second reference position

Parameter 1242 :

Machine coordinates of the third reference position

Parameter 1243 :

Machine coordinates of the fourth reference position

3) Parameters related to automatic coordinate system setting

Parameter 1201, bit 0 :

Enables the automatic coordinate system setting function.

Parameter 1201, bit 1 :

Selects the parameter specifications of the coordinates of the reference position with which the coordinate system is automatically set.

Parameter 1250 :

Coordinates of the reference position

Parameter 1251 :

Coordinates of the reference position (when bit 1 of parameter 1201 is set to 1 in inch input)

Parameters related to manual operation (JOG)

Parameter 1002, bit 0 :

Number of axes that are simultaneously controlled in jog mode

Parameter 1423 :

Jog feedrate

Parameter 1424 :

Jog rapid traverse rate

Parameter related to cutting feed

Parameter 1422 :

Maximum cutting feedrate

Parameters related to rapid traverse

Parameter 1401, bit 1 :

Selects the linear interpolation positioning function.

Parameter 1401, bit 4 :

Selects whether movement is stopped when the cutting feedrate override becomes 0% during rapid traverse.

Parameter 1401, bit 6 :

Selects whether a rapid traverse command can be executed during a dry run.

Parameter 1420 :

Rapid traverse rate

Parameter 1421 :

F0 velocity of rapid traverse override

Parameter 1601, bit 4 :

Selects the rapid traverse block overlap function.

Parameter 1722 :

Rapid traverse rate deceleration ratio for rapid traverse block overlap

Parameters related to dry run

Parameter 1401, bit 6 :

Selects whether a rapid traverse command can be executed during a dry run.

Parameter 1410 :

Dry run speed

Parameters related to acceleration/deceleration

1) Rapid traverse linear acceleration/deceleration

Parameter 1620 :

Time constant for rapid traverse linear acceleration /deceleration

2) Rapid traverse bell–shaped acceleration/deceleration (optional)

Parameter 1620 :

Time constant T1 for rapid traverse bell–shaped acceleration /deceleration

Parameter 1621 :

Time constant T2 for rapid traverse bell–shaped acceleration /deceleration

3) Exponential acceleration/deceleration during cutting feed

Parameter 1622 :

Time constant for exponential acceleration/deceleration during cutting feed

Parameter 1623 :

FL velocity for exponential acceleration/deceleration during cutting feed

4) Exponential acceleration/deceleration during jog feed

Parameter 1624 :

Time constant for exponential acceleration/deceleration during jog feed

Parameter 1625 :

FL velocity for exponential acceleration/deceleration during jog feed

Parameters related to PMC axis control

Parameter 8001, bit 0 :

Disables machine lock signal MLK under PMC axis control.

Parameter 8001, bit 2 :

Selects specifications such that signals related to dry run and override under PMC axis control are separate from the signals for the CNC axes.

Parameter 8001, bit 3 :

Enables a rapid traverse command to be executed during a dry run under PMC axis control.

Parameter 8002, bit 0 :

Selects a rapid traverse rate under PMC axis control.

Parameter 8002, bit 3 :

Selects the units in which cutting feedrate is specified under PMC axis control.

Parameter 8010 :

Selects the DI/DO group of axes under PMC axis control.

Parameters related to manual handle feed

Parameter 7100, bit 0 :

Enables a manual pulse generator in jog mode. Alternatively, enables incremental feed in the handle or teach in handle mode.

Parameter 7100, bit 1 :

Enables a manual pulse generator in the TEACH IN JOG mode.

Parameter 7102, bit 0 :

Selects the direction of rotation for the manual pulse generator and the direction of travel for each axis.

Parameter 7110 :

Number of manual pulse generators used

Parameter 7113 :

Magnification m of manual handle feed

Parameter 7114 :

Magnification n of manual handle feed

Parameters related to backlash

Parameter 1800, bit 4 :

Selects whether separate backlash compensation is performed for cutting feed and rapid traverse.

Parameter 1851 :

Backlash compensation

Parameter 1852 :

Backlash compensation during rapid traverse

Parameters related to in–position check

Parameter 1601, bit 5 :

Disables in–position check during deceleration.

Parameter 1801, bit 4 :

Selects a parameter for in–position width between cutting blocks.

Parameter 1826 :

In–position width

Parameter 1827 :

In–position width between cutting blocks

Parameters related to interlock

Parameter 3003, bit 0 :

Disables the interlock signal.

Parameter 3003, bit 2 :

Disables the interlock signal for each axis.

Parameters related to stroke limit

1) Common

Parameter 1300, bit 7 :

Selects whether an overtravel alarm is output before a limit is reached.

2) Stored stroke limit 1

Parameter 1300, bit 2 :

Enables switching signal EXLM of stored stroke limit 1.

Parameter 1320 :

Positive coordinate I of stored stroke limit 1

Parameter 1321 :

Negative coordinate I of stored stroke limit 1

Parameter 1326 :

Positive coordinate II of stored stroke limit 1

Parameter 1327 :

Negative coordinate II of stored stroke limit 1

3) Stored stroke limit 2 (optional)

Parameter 1300, bit 0 :

Selects the stored stroke limit 2 prohibited area.

Parameter 1310, bit 0 :

Selects whether the stored stroke limit 2 check function is supported (within the prohibited area).

Parameter 1322 :

Positive coordinate of stored stroke limit 2

Parameter 1323 :

Negative coordinate of stored stroke limit 2

4) Stored stroke limit 3 (optional)

Parameter 1310, bit 1 :

Selects whether the stored stroke limit check 3 function is supported.

Parameter 1324 :

Positive coordinate of stored stroke limit 3

Parameter 1325 :

Negative coordinate of stored stroke limit 3

Parameters related to the servo system

Parameter 3111, bit 0 :
Enables the servo setting screen.
Parameter 1800, bit 1 :
Suppresses an alarm when VRDY is set to on before PRDY is set to on.
Parameter 1820 :
CMR
Parameter 1821 :
Capacity of reference counter
Parameter 1825 :
Servo loop gain
Parameter 1850 :
Grid shift
Parameter 2000, bit 0 :
High–resolution bit
Parameter 2000, bit 1 :
Automatic servo parameter setting
Parameter 2001 :
AMR
Parameter 2020 :
Motor type
Parameter 2021 :
Load inertia ratio
Parameter 2022 :
Direction of motor revolution
Parameter 2023 :
Number of velocity detection feedback pulses
Parameter 2024 :
Number of position detection feedback pulses
Parameter 2084 :
DMR numerator for flexible feed gear
Parameter 2085 :
DMR denominator for flexible feed gear

NOTE
All other parameters numbered between 2000 to 2999 are automatically set, being adjusted by the user only when required.

Parameters related to the absolute pulse coder

Parameter 1815, bit 4 :
Determines the reference position.
Parameter 1815, bit 5 :
Selects an absolute pulse coder.
Parameter 1860 :
APC counter value at the reference position
Parameter 1861 :
APC counter value at the reference position (continued from parameter 1860)

Parameters related to excessive errors

Parameter 1828 :

Position error limit during travel

Parameter 1829 :

Position error limit in stop state

Parameter 3410 :

Arc radius error limit

Parameters related to the MDI

Parameter 3100, bit 3 :

Selects the MDI keyboard.

Parameter 3100, bit 7 :

Selects color display for the nine–inch high–resolution.

Parameters related to display

1) Display language

Parameter 3102, bit 0 :

Selects Japanese as the display language. (optional)

2) Actual speed

Parameter 3105, bit 0 :

Selects the specifications for actual speed display.

Parameter 3105, bit 1 :

Selects specifications such that any movement of a PMC controlled axis is not added to the actual speed display.

3) Program list display

Parameter 3107, bit 0 :

Selects specifications such that the program list display includes numbers and names.

Parameter 3107, bit 4 :

Selects specifications such that the program list display arranges numbers in ascending order.

4) Loader name

Parameter 3141 :

First character of loader name

Parameter 3142 :

Second character of loader name

Parameter 3143 :

Third character of loader name

Parameter 3144 :

Fourth character of loader name

Parameter 3145 :

Fifth character of loader name

Parameter 3146 :

Sixth character of loader name

Parameter 3147 :

Seventh character of loader name

5) Others

Parameter 3107, bit 7 :

Selects specifications such that the program display screen indicates a modal state.

Parameter 3111, bit 7 :

Selects specifications such that the alarm/message screen is not displayed when an alarm is issued or when an operator message is input.

Parameter 3115, bit 0 :

Selects specifications such that the current position of each axis is not displayed.

Parameters related to DI/DO signals

Parameter 3001, bit 2 :

Selects the specifications for the reset and rewind signal RRW.

Parameter 3017 :

Extended output period for reset signal RST

Parameters related to clear and reset

Parameter 3203, bit 7 :

Selects specifications such that a reset clears a program created in MDI mode.

Parameter 3402, bit 0 :

Sets G01 mode at power–on and in the clear state.

Parameter 3402, bit 4 :

Sets G98 mode at power–on and in the clear state.

Parameter 3402, bit 6 :

Selects specifications such that the clear state is established at reset.

Parameter 3406, bit 1 :

Does not clear group number 01 when bit 6 of parameter 3402 is set to 1.

Parameter 3406, bit 2 :

Does not clear group number 02 when bit 6 of parameter 3402 is set to 1.

Parameter 3406, bit 3 :

Does not clear group number 03 when bit 6 of parameter 3402 is set to 1.

Parameter 3406, bit 4 :

Does not clear group number 04 when bit 6 of parameter 3402 is set to 1.

Parameter 3406, bit 5 :

Does not clear group number 05 when bit 6 of parameter 3402 is set to 1.

Parameter 3407, bit 1 :

Does not clear group number 09 when bit 6 of parameter 3402 is set to 1.

Parameter 3407, bit 6 :

Does not clear group number 14 when bit 6 of parameter 3402 is set to 1.

Parameter 3408, bit 0 :

Does not clear group number 16 when bit 6 of parameter 3402 is set to 1.

Parameter 3409, bit 7 :

Does not clear the F code when bit 6 of parameter 3402 is set to 1.

Parameters related to miscellaneous functions

Parameter 3001, bit 7 :

Selects whether the high–speed MST method is used.

Parameter 3010 :

MF or SF delay

Parameter 3011 :

Width in which the completion signal FIN is accepted

Parameter 3030 :

Number of digits that can be specified for an M code

Parameter 3031 :

Number of digits that can be specified for an S code

Parameter 3404, bit 5 :

Selects specifications such that the beginning of a program is not located by M02 in memory operation.

Parameter 3404, bit 7 :

Enables a multiple M code command.

Parameter 3411 :

M code 1 not to be buffered

Parameter 3412 :

M code 2 not to be buffered

Parameter 3413 :

M code 3 not to be buffered

Parameter 3414 :

M code 4 not to be buffered

Parameter 3415 :

M code 5 not to be buffered

Parameter 3416 :

M code 6 not to be buffered

Parameter 3417 :

M code 7 not to be buffered

Parameter 3418 :

M code 8 not to be buffered

Parameter 3419 :

M code 9 not to be buffered

Parameter 3420 :

M code 10 not to be buffered

Parameter related to skip

Parameter 6200, bit 7 :

Enables dry run, overtravel, and automatic acceleration /deceleration for a skip command.

Parameters related to macros

1) Single block stop

Parameter 6000, bit 5 :

Enables a single block stop by a custom macro statement.

2) Macro variable

Parameter 3290, bit 2 :

Prohibits a macro variable from being input using the MDI keys.

Parameter 6001, bit 6 :

Selects specifications such that a reset does not clear macro variables 100 to 149.

Parameter 6001, bit 7 :

Selects specifications such that a reset does not clear macro variables 1 to 33.

Parameter 6036 :

Number of custom macro variables shared by the loader and NC (Variable numbers 100 to 149)

Parameter 6037 :

Number of custom macro variables shared by the loader and NC (Variable numbers 500 to 531)

WARNING

The values of parameters 6036 and 6037 must agree with the corresponding NC values. Otherwise, normal operation cannot be performed.

3) Subprogram call function (M198)

Parameter 3404, bit 2 :

Selects specifications such that address P in the subprogram call function indicates a program number.

Parameter 6030 :

M code of subprogram call function (When 0 is specified, M198 is assumed.)

4) External output

Parameter 6001, bit 1 :

Selects the specifications related to leading zeros in data output by the DPRINT command.

Parameter 6001, bit 4 :

Selects the specifications related to the end code after data output in ISO code by the BPRINT or DPRINT command is completed.

Parameter 6010 :

Sets the hole pattern corresponding to an EIA code representing an asterisk (*).

Parameter 6011 :

Sets the hole pattern corresponding to an EIA code representing an equal sign (=).

Parameter 6012 :

Sets the hole pattern corresponding to an EIA code representing a sharp(#).

Parameter 6013 :

Sets the hole pattern corresponding to an EIA code representing an opening square bracket ([).

Parameter 6014 :

Sets the hole pattern corresponding to an EIA code representing a closing square bracket (]).

5) Custom macro call by a G code

Parameter 6050 :

G code for calling a custom macro of program number 9010

Parameter 6051 :

G code for calling a custom macro of program number 9011

Parameter 6052 :

G code for calling a custom macro of program number 9012

Parameter 6053 :

G code for calling a custom macro of program number 9013

Parameter 6054 :

G code for calling a custom macro of program number 9014

Parameter 6055 :

G code for calling a custom macro of program number 9015

Parameter 6056 :

G code for calling a custom macro of program number 9016

Parameter 6057 :

G code for calling a custom macro of program number 9017

Parameter 6058 :

G code for calling a custom macro of program number 9018

Parameter 6059 :

G code for calling a custom macro of program number 9019

6) Subprogram call by an M code

Parameter 6071 :

M code for calling a custom macro of program number 9001

Parameter 6072 :

M code for calling a custom macro of program number 9002

Parameter 6073 :

M code for calling a custom macro of program number 9003

7) Subprogram call by an M code

Parameter 6080 :

M code for calling a custom macro of program number 9020

Parameter 6081 :

M code for calling a custom macro of program number 9021

Parameter 6082 :

M code for calling a custom macro of program number 9022

Parameter 6083 :

M code for calling a custom macro of program number 9023

Parameter 6084 :

M code for calling a custom macro of program number 9024

Parameter 6085 :

M code for calling a custom macro of program number 9025

Parameter 6086 :

M code for calling a custom macro of program number 9026

Parameter 6087 :

M code for calling a custom macro of program number 9027

Parameter 6088 :

M code for calling a custom macro of program number 9028

Parameter 6089 :

M code for calling a custom macro of program number 9029

8) Subprogram call by an ASCII code

Parameter 6090 :

ASCII code for calling a subprogram of program number 9004

Parameter 6091 :

ASCII code for calling a subprogram of program number 9005

9) Interrupt–type custom macro

Parameter 6003, bit 1 :

Sets absolute coordinates as skip coordinates when a custom macro interrupt occurs.

Parameter 6003, bit 2 :

Selects a custom macro interrupt type.

Parameter 6003, bit 3 :

Selects the trigger method for interrupt signal UNIT for a custom macro.

Parameter 6003, bit 4 :

Selects M code numbers for enabling and disabling a custom macro interrupt.

Parameter 6003, bit 5 :

Selects how local variables of an interrupt program are handled.

Parameter 6003, bit 6 :

Enables a custom macro interrupt during cyclic operation.

Parameter 6003, bit 7 :

Enables an interrupt–type custom macro.

Parameter 6033 :

M code that enables a custom macro interrupt

Parameter 6034 :

M code that disables a custom macro interrupt

10) Parameters related to custom macro variables shared by the loader and NC

Parameter 6036 :

Number of custom macro variables shared by the loader and NC (macro numbers 100 to 149)

Parameter 6037 :

Number of custom macro variables shared by the loader and NC (macro numbers 500 to 531)

Parameters related to the position switch

Parameter 6910 :

Axis corresponding to the first position switch

Parameter 6911 :

Axis corresponding to the second position switch

Parameter 6912 :

Axis corresponding to the third position switch

Parameter 6913 :

Axis corresponding to the fourth position switch

Parameter 6914 :

Axis corresponding to the fifth position switch

Parameter 6915 :

Axis corresponding to the sixth position switch

Parameter 6916 :

Axis corresponding to the seventh position switch

Parameter 6917 :

Axis corresponding to the eighth position switch

Parameter 6918 :

Axis corresponding to the ninth position switch

Parameter 6919 :

Axis corresponding to the tenth position switch

Parameter 6930 :

Maximum value for the operating area of the first position switch

Parameter 6931 :

Maximum value for the operating area of the second position switch

Parameter 6932 :

Maximum value for the operating area of the third position switch

Parameter 6933 :

Maximum value for the operating area of the fourth position switch

Parameter 6934 :

Maximum value for the operating area of the fifth position switch

Parameter 6935 :

Maximum value for the operating area of the sixth position switch

Parameter 6936 :

Maximum value for the operating area of the seventh position switch

Parameter 6937 :

Maximum value for the operating area of the eighth position switch

Parameter 6938 :

Maximum value for the operating area of the ninth position switch

Parameter 6939 :

Maximum value for the operating area of the tenth position switch

Parameter 6950 :

Minimum value for the operating area of the first position switch

Parameter 6951 :

Minimum value for the operating area of the second position switch

Parameter 6952 :

Minimum value for the operating area of the third position switch

Parameter 6953 :

Minimum value for the operating area of the fourth position switch

Parameter 6954 :

Minimum value for the operating area of the fifth position switch

Parameter 6955 :

Minimum value for the operating area of the sixth position switch

Parameter 6956 :

Minimum value for the operating area of the seventh position switch

Parameter 6957 :

Minimum value for the operating area of the eighth position switch

Parameter 6958 :

Minimum value for the operating area of the ninth position switch

Parameter 6959 :

Minimum value for the operating area of the tenth position switch

Parameter related to DI/DO on the loader control board

Parameter 7902, bit 1 :

Enables matrix expansion for the loader operator’s panel.

Parameters related to multipath control

Parameter 8100, bit 7 :

Makes the servo activation timing of the loader and NC independent.

Parameter 8101, bit 0 :

Selects whether a waiting M code is buffered.

Parameter 8102, bit 0 :

Increases the number of loader–NC communication signals.

Parameter 8110 :

Range of waiting M codes (minimum)

Parameter 8111 :

Range of waiting M codes (maximum)

A.2 DETAILS OF PARAMETERS

This section describes the special parameters that are provided for loader control.

For details of the other parameters described in Section A.1, refer to
”Series 16/18–MODEL A Parameter Manual (B–61810E)”,
”Series 16/18/160/180–MODEL B Parameter Manual (B–62450E)”,
”Series 16/18/160/180–MODEL C Parameter Manual (B–62760EN)”, or
”Series 21/210 Parameter Manual (B–62710EN)”
”Series 16*i*/18*i*/160*i*/180*i*–MODEL A Parameter Manual (B–63010EN) or series 21*i*/210*i* MODEL–A Parameter Manual (B–63090EN)”

A.2.1 Parameters Related to Loader Control

3141	Loader name (first character)
3142	Loader name (second character)
3143	Loader name (third character)
3144	Loader name (fourth character)
3145	Loader name (fifth character)
3146	Loader name (sixth character)
3147	Loader name (seventh character)

Data type : Bit

Set a loader name by using character codes. (Instead of the loader name LC, an arbitrary character string, not longer than seven characters, consisting of alphanumeric characters, katakana characters, and symbols can be displayed on the CRT screen.)

NOTE
1 For detailed information about the character codes, see the character code correspondence table.
2 When character code 0 is set, LC is displayed.

[Example] Setting the loader name “LOADER”
Parameter No. 3141=76 (L)
Parameter No. 3142=79 (O)
Parameter No. 3143=65 (A)
Parameter No. 3144=68 (D)
Parameter No. 3145=69 (E)
Parameter No. 3146=82 (R)
Parameter No. 3147=00 ( )

	#7	#6	#5	#4	#3	#2	#1	#0 (bit)
7902							MTX	

Data type : Bit

MTX Selects whether the loader operator's panel input/output signals of the loader control board (TDI01 to TDI08, TDO01 to TDO06, TCOM1 to TCOM4) are expanded as a matrix in the range of X1010 to X1013 and Y1010 to Y1013.

0 : Matrix expansion is not performed.

1 : Matrix expansion is performed.

CAUTION
1 When matrix expansion is performed, signals TDI1 to TDI8, TDO1 to TDO6, and TCOM1 to TCOM4 cannot be used. The DO signals of Y1010 to Y1013 are used for LEDs hence cannot be used for on/off control.
2 The Series 16*i*/18*i*/21*i* does not support matrix expansion.

A.2.2 Parameters Related to Custom Macros

6036	Number of custom macro variables shared by the loader and NC (macro numbers 100 to 149)

Data type : Byte
Unit of data : Item
Valid data range : 0 to 50

Specify the number of custom macro variables 100 to 149 that are shared by the loader and NC (custom macro variables shared by tool posts).

A custom macro variable that is shared by the loader and NC can be written to and read from either the loader or NC.

[Example] When 10 is set in parameter 6036

#100 to #109 : Custom macro variables shared by the loader and NC

#110 to #149 : Custom macro variables that are not shared by the loader and NC

NOTE
When 0 is specified, none of custom macro variables 100 to 149 are shared by the loader and NC.

6037	Number of custom macro variables shared by the loader and NC (macro numbers 500 to 531)

Data type : Byte
Unit of data : Item
Valid data range : 0 to 32

Specify the number of custom macro variables 500 to 531 that are shared by the loader and NC.

A custom macro variable shared by the loader and NC can be written to and read from either the loader or NC.

[Example] When 10 is set in parameter 6037

#500 to #509 : Custom macro variables shared by the loader and NC

#510 to #531 : Custom macro variables that are not shared by the loader and NC

NOTE
When 0 is specified, none of custom macro variables 500 to 531 are shared by the loader and NC.

A.2.3 Multipath Control Parameters

	#7	#6	#5	#4	#3	#2	#1	#0
8100	NWP						IAL	RST

Data type : Bit

RST The reset key on the CRT/MDI panel is effective:

0 : For both the loader and NC.

1 : Only for the path displayed on the screen.

CAUTION
When setting this parameter to 1, also set bit 0 of NC parameter 8100 to 1.

IAL When an NC alarm occurs during automatic operation, the loader:

0 : Enters the feed hold state and stops.

1 : Continues automatic operation.

NWP The servo activation timing is:

0 : The same for the loader and NC. (Reset processing terminates only when the NC becomes ready for activation.)

1 : Different for the loader and NC.

CAUTION
When setting this parameter to 1, also set bit 7 of NC parameter 8100 to 1.

	#7	#6	#5	#4	#3	#2	#1	#0
8101								MWB

Data type : Bit

MWB A waiting M code is:

0 : Buffered.

1 : Not buffered.

	#7	#6	#5	#4	#3	#2	#1	#0
8102								S19

Data type : Bit

S19 The PMC of the loader and NC use:

0 : 96 communication signals.

1 : 192 communication signals. (G1212 to G1219, G1252 to G1255, F1212 to F1219, and F1252 to F1255 are used.)

NOTE
When this parameter is changed, a power–down request occurs. Only the loader supports this parameter.

8110	Waiting M code range (minimum value)

Data type : 2 words

Valid data range : 0 and 100 to 99999999

This parameter specifies the minimum value of the waiting M code.

The waiting M code range is specified using parameter 8110 (minimum value) and parameter 8111 (maximum value).

(parameter 8110) ≤ (waiting M code) ≤ (parameter 8111)

NOTE
A value of 0 indicates that the waiting M code is not used.

8111	Waiting M code range (maximum value)

Data type : 2 words

Valid data range : 0 and 100 to 99999999

This parameter specifies the maximum value of the waiting M code

[A]

[B]

[C]

[D]

[E]

[G]

[I]

[L]

[M]

[O]

[P]

[S]

[T]

[W]

Revision Record

FANUC Series 21/16/18/160/180 LOADER CONTROL CONNECTION MANUAL (B–62443EN–2)

Revision	Date	Contents	Revision	Date	Contents
03	Aug.,’97	• Addition of Series 16*i*/18*i*/21*i*/160*i*/180*i*/210*i*–MODEL A			
02	Aug., ’96	• Addition of Series 16/18/160/180–MODEL C and Series 21–TB • Correction of errors			
01	Jun., ’95				