PRELIMINARY

F159 *PLUG-IN WEIGHT MODULE for the OMRON SYSMAC CJ1 SERIES PLC*

OPERATION MANUAL

UNIPULSE

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Rev. 1.01

Introduction

Backplane Free — Function Block — Program Standardization

The high speed F159 weighing controller is designed to provide efficient production control functions in a wide variety of process weighing applications. The F159 directly plugs into the state-of-the-art Omron CJ1 series PLC.

This direct connectivity shortens the system development time when implementing a process weighing system by simplifying the setup of the operation, reducing wiring and interfacing cables, drastically reducing the cost of systems' configuration and programming time for the systems integrator and designers.

The slim F159 combines with the CJ1 to provide an excellent solution for process weighing systems. This combination aids in the downsizing of the controlling installation site. Since the F159 possesses weighing information at a rate of 500 times per second, this high data processing speed allows for additional internal measurements, of smaller fluctuations of the weight, at a higher resolution, which increases the productivity of the weighing system.

The applications for the F159 weigh module includes: Hopper scales, Packing scales, Bag filling systems, Rotary filling systems and many other weight based control systems. The F159 can excite up to four (4) 350 ohm load cells while still providing up to 1/40,000 division resolution.

The F159 stores all the weighing system set up values and the complete feeding / discharge / weighing control sequence internal to itself, significantly reducing the burden imposed on the CJ1. This synergy between the PLC and weighing instrumentation improves system speed and reduces system configuration times.

Functions already programmed into the F159 include: Auto free fall compensation; Fast-Slow-Dribble filling, Final, High/Low, Tare, and Zero Tracking functions. Powerful analog filters and selectable moving average digital filters are used to eliminate the mechanical vibration to achieve the higher weighing accuracy.

Low development costs, quick system interfacing, high speed and accuracy, and reduced PLC overhead, all combine to make the F159 weight controller a best buy choice for your most demanding weight based process control applications.

Safety Precautions

Be sure to read for safety.

In order to have an F159 Weight Module used safely, notes I would like you to surely follow divide into ⚠ WARNING and ⚠ CAUTION, and are indicated by the following documents. Notes indicated here are the serious contents related safety.Please use it after understanding the contents well.

⚠ WARNING

Misuse may cause the risk of death or serious injury to persons.

⚠ CAUTION

Misuse may cause the risk of injury to persons or damage to property.

⚠ WARNING

- Use F159 with correct supply voltage.
- Do not carry out the direct file of the commercial power supply to a signal input terminal.
- Carefully check wiring, etc. before applying power.
- Do not disassemble the main body for modifications or repair.
- Be sure to perform Type III earth works when installing the main body.
- When smoke, a nasty smell, or strange sound, please shut off a power supply immediately and extract a power supply cable.
- Do not install in the following environments.
  - Places containing corrosive gas or flammable gas.
  - Where the product may be splashed with water, oil or chemicals.

⚠ CAUTION

● Be sure to disconnect the power cable when performing the following.
- Wiring/connection of cables to terminal blocks.

● Take an interval of more than 5 seconds when repeating ON/OFF.

● Use shielded cables for the connection of strain gauge type sensor or External output.

● Take adequate shielding measures when using at the following locations.
- Near a power line.
- Where a strong electric field or magnetic field is formed.
- Where static electricity, relay noise or the like is generated.

● Do not install in the following environments.
- Where the temperature and/or humidity exceeds the range in the specifications.
- Places with large quantities of salt or iron powder.
- Where the main body is directly affected by vibration or shock.

● Do not use it, broken down.

CONTENTS

1. APPEARANCE DESCRIPTION 1

1-1. Front Panel 1

1-2. Status LED 2

1-3. Unit Number Selection Switch 3

1-4. DIP Switch 4

2. CONNECTION 5

2-1. F159 Block Terminal 5

2-2. Load Cell Connection 5
2-2-1 6-wire Connection 6
2-2-2 4-wire Connection 6
2-2-3 Connecting Load cells in Parallel 8

2-3. Output Connection 12
2-3-1 Equivalent Circuit 12

2-4. Connections to Terminal Block 13

3. DATA EXCHANGE WITH CPU 14

3-1. High Performance I/O Unit Restart Flag 15

3-2. Relay Area 16
3-2-1 Allocation of Weight and Status Data 16
3-2-2 OUT (CPU unit → F159) 16
3-2-3 IN (F159 → CPU unit) 19
3-2-4 Register Allocations for Weighing Control 28
3-2-5 Register Allocations for Initial Settings 29

4. CALIBRATION 37

4-1. What is Calibration? 37

4-2. Actual Load Calibration Procedure 38

4-3. Preparation for Calibration 39
4-3-1 LOCK Release 39
4-3-2 Setting Initial Data 40

4-4. Zero Calibration 44

4-5. Span Calibration 47

5. DISPLAY SETTINGS 50

5-1. Digital Filter 50

5-2. Analog Filter 50

5-3. Digital Filter 2 51

5-4. Motion Detection (MD) 52

5-5. Zero Tracking (ZT) 54

5-6. Digital Zero (DZ) 55

5-7. Digital Zero Clear 55

5-8. DZ Regulation 55

5-9. One-Touch Tare Subtraction 56

5-10. One-Touch Tare Subtraction Reset 56

5-11. Digital Tare Subtraction 57

5-12. Restriction on Tare Subtraction 57

5-13. Sign Reversal during Discharge Control 58

6. WEIGHING MODE SETTING AND OPERATION 59

6-1. Feed Weighing and Discharge Weighing 60
6-1-1 Feed Weighing 60
6-1-2 Discharge Weighing 63
6-1-3 Weighing Mode 66

6-2. Simple Comparison Control and Sequence Control 67
6-2-1 Simple Comparison Control 67
6-2-2 Sequence Control 69
6-2-3 Mode Selection 74

6-3. FF CPS. Regulation Value / Free Fall Compensation / Avg. Count of FF CPS. / FF CPS. Coefficient 75

6-4. Final / Set Point 2 / Set Point 1 / FF CPS. / Over / Under 78

6-5. Near Zero / Upper Limit / Lower Limit 79

6-6. U/L Limit Comparison / U/L Limit Comparison Mode/ Near Zero Comparison / Over/Under Comparison / Over/Under Comparison Mode 80

6-7. Complete Signal Output Mode / Complete Output Time / Compare time / Comparison Inhibit Time 82

6-8. Judging Times / AZ Times / At Start NZ Confirmation / At Start WV Confirmation /Auto Jog (ON/OFF) / Auto Jog Timer .. 83

6-9. Net Weight Over / Gross Weight Over 87

7. LADDER DIAGRAM 88

8. SETTING VALUES LIST 95

9. ERROR CODE 97

9-1. Error Code and Error Assistance Code 97

9-2. Error Description 98
9-2-1 Calibration Error 98
9-2-2 Weight Error 102
9-2-3 Sequence Error 104

10. BLOCK DIAGRAM 106

11. DIMENSIONS 107

12. INSTALLATION 108

12-1. Connection with CJ1 Unit 108

12-2. DIN Rail Installation 110

13. SPECIFICATIONS 112

13-1. Analog Section 112

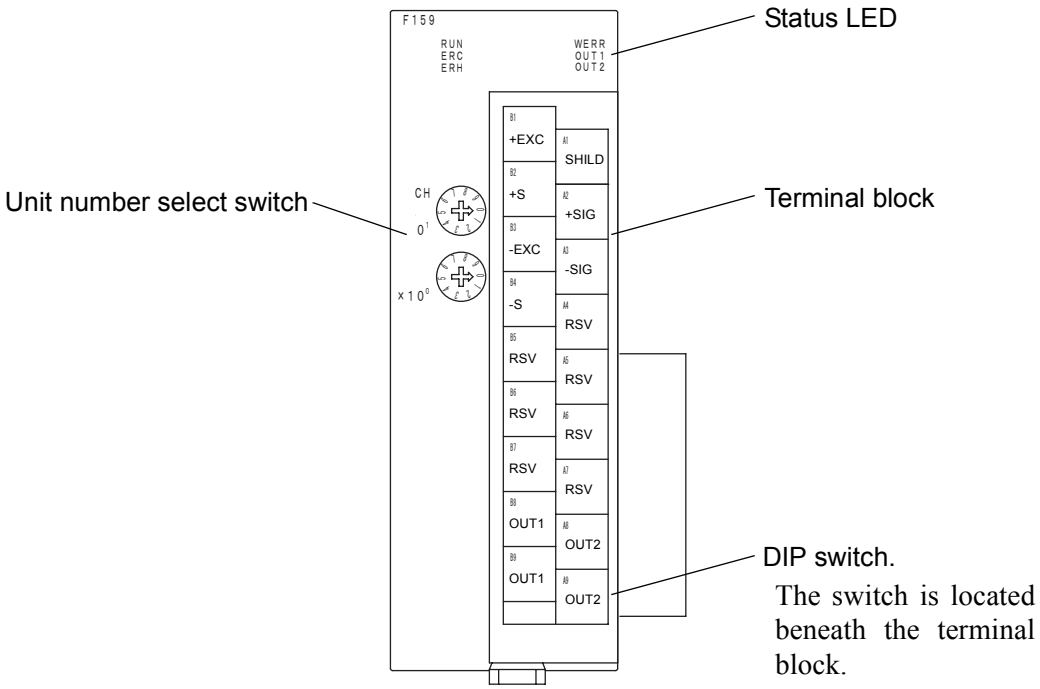
13-2. Display 113

13-3. Setting 113

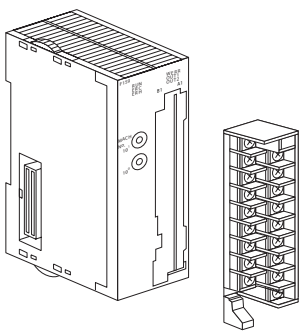
13-4. General Specifications 114

1. APPEARANCE DESCRIPTION

1-1. Front Panel



⚠ CAUTION



Terminal block can be detached by pulling down the lever. Normally, the lever should be in upper position.

Always turn off the CJ1's voltage source before trying to attach/detach the terminal block.

1-2. Status LED

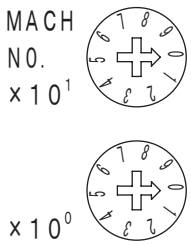
Status LEDs display the current operating status of the unit. The following table summaries their names and meanings.

LED	Name	State	Description
RUN (Green)	Operation status	ON	Normal operation
		OFF	Data exchange with CPU has been aborted
ERC (Red)	Error detected by the unit	ON	Error occurred in F159
		OFF	Normal operation
ERH (Red)	CPU error	ON	Error occurred during data exchange with CPU
		OFF	Normal operation
WERR (Red)	Weight error	ON	One or more of the following alarms are in place: ± LOAD, OFL1, OFL2, OFL3, ZALM
		OFF	Normal operation
OUT1 (Orange)	OUT1 output	ON	OUT1 =ON
		OFF	OUT1 = OFF
OUT2 (Orange)	OUT2 output	ON	OUT2 = ON
		OFF	OUT2 = OFF

1-3. Unit Number Select Switch

F159 acts as a high performance weighing processing module for Omron SYS-MAC CJ1 series PLC. The data exchange between CPU unit and F159 are carried out by the high performance relay area of I/O and DM area.

Relay and DM number used by F159 can be selected by the unit number selection switch located on the front panel.

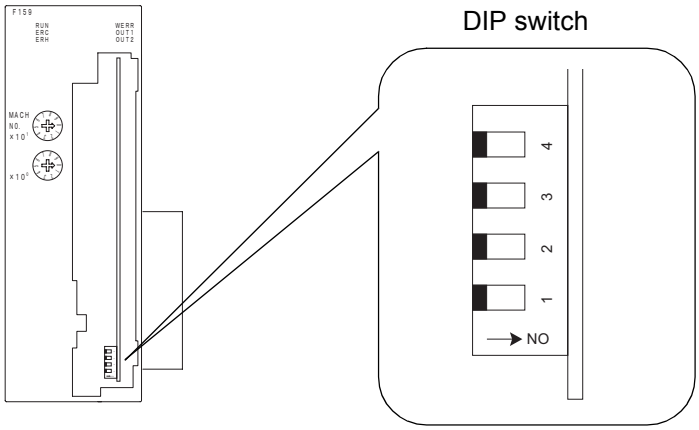


Switch No.	Unit No.	Channel number allocated to the I/O unit relay area	DM number allocated to the I/O unit DM area
0	0	2000 - 2009CH	D20000 - 20099
1	1	2010 - 2019CH	D20100 - 20199
2	2	2020 - 2029CH	D20200 - 20299
3	3	2030 - 2039CH	D20300 - 20399
4	4	2040 - 2049CH	D20400 - 20499
5	5	2050 - 2059CH	D20500 - 20599
6	6	2060 - 2069CH	D20600 - 20699
7	7	2070 - 2079CH	D20700 - 20799
8	8	2080 - 2089CH	D20800 - 20899
9	9	2090 - 2099CH	D20900 - 20999
10	10	2100 - 2109CH	D21000 - 21099
≀	≀	≀	≀
n	n	2000 + n × 10 - 2000 + n × 10 + 9CH	D20000 + n × 100 - D20000 + n × 100 + 99
≀	≀	≀	≀
95	95	2950 - 2959CH	D29500 - 29599

Unit number must be unique: duplicate use of the same number for multiple of I/O units will cause operation error “Error: Duplicate use of unit No.” (“Duplicate use of unit No.” in programming console), disabling normal operation (A40113 turns ON).

1-4. DIP Switch

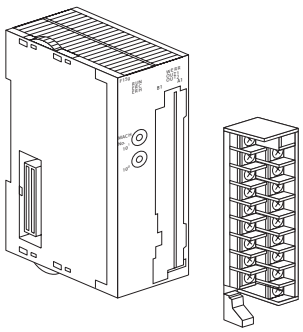
DIP switch is used to LOCK calibration and restore default settings.



Switch No.	State	
	ON	OFF
1	Calibration LOCK ON	Calibration LOCK OFF
2	Default set ON	Default set OFF
3	Undefined	Undefined
4	Undefined	Undefined

Switch 3 and 4 are undefined: they should always be set to OFF position.

⚠ CAUTION



Terminal block can be detached by pulling down the lever. Normally, the lever should be in upper position.

Always turn off the CJ1's voltage source before trying to attach/detach the terminal block.

2. CONNECTION

2-1. F159 Block Terminal

+EXC	B1
+S	B2
-EXC	B3
-S	B4
RSV	B5
RSV	B6
RSV	B7
OUT1	B8
OUT1	B9

A1	SHIELD
A2	+SIG
A3	-SIG
A4	RSV
A5	RSV
A6	RSV
A7	RSV
A8	OUT2
A9	OUT2

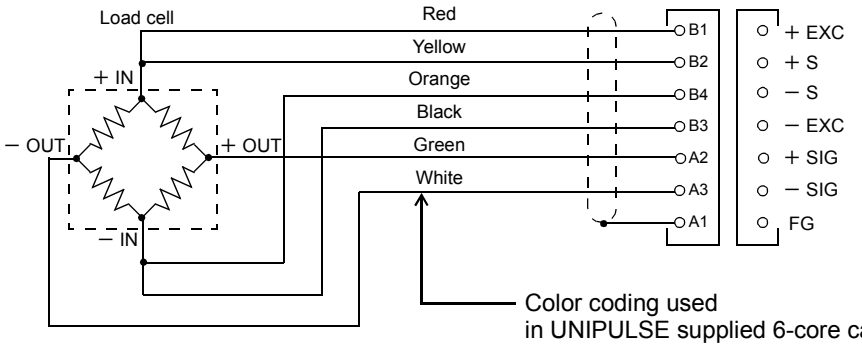
2-2. Load Cell Connection

Connect leads from the load cell to F159 terminal block.

	Load cell signal	
F159	6-wire connection	4-wire connection
+EXC	+EXC	+EXC
+S	+S	connected to +EXC
-EXC	-EXC	-EXC
-S	-S	connected to -EXC
+SIG	+SIG	+SIG
-SIG	-SIG	-SIG
SHIELD	SHIELD	SHIELD

2-2-1. 6-wire Connection

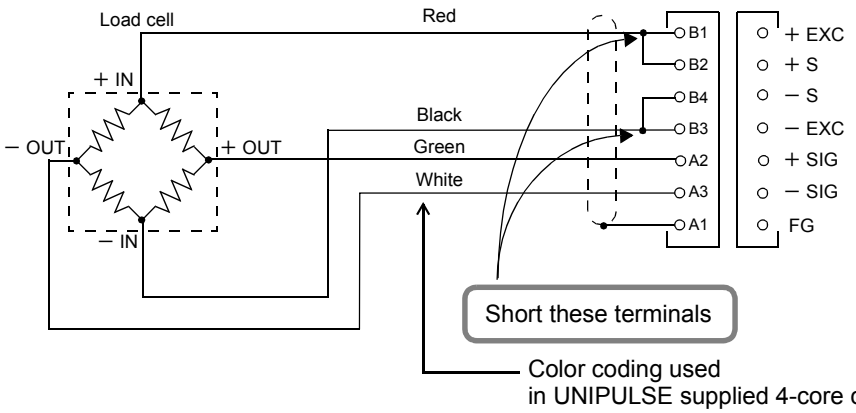
F159 input uses an accurate 6-wire load cell connection (remote sense method). Use shielded 6-core cable for this connection and route it apart from noisy lines (power and digital devices) and AC power lines.



※ Remote sense method can apply correct voltage to the load cell compensating cable resistance change due to temperature variation along the cable. It is capable of stabilizing excitation voltage in the vicinity of the load cell.

2-2-2. 4-wire Connection

F159 is also capable of 4-wire connection, in which case additional jumper connections between B1 and B2, and B3 and B4 are required. Although the system may function apparently correctly with B2 and B4 open, this configuration can produce over-voltage excitation, resulting in over heating and damage of the load cell. Connect these terminals using the supplied short-bars.



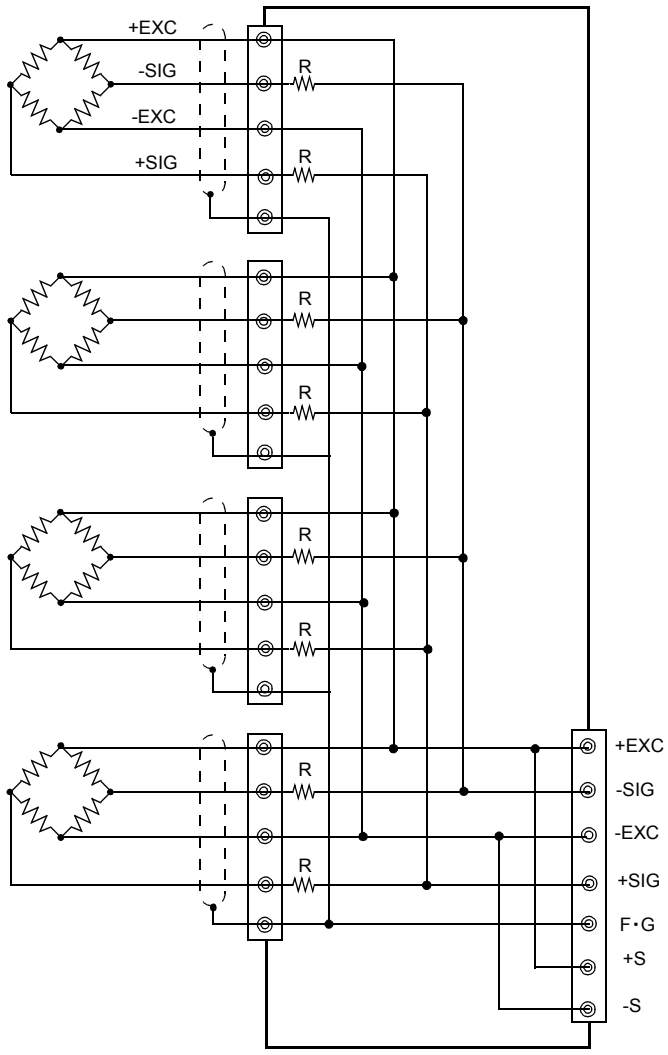
⚠ CAUTION

- F159 supplies 10V excitation voltage. Use a load cell with rated excitation voltage of 10V or higher, otherwise abnormal heating and damage to the cell may result.
- If you use F159 using 4-wire connection configuration, never fail to connect between +EXC and +S, and –EXC and –S. Although the system may function apparently well without these jumpers, over-voltage excitation can occur any time resulting in anomalous heating and damage to the load cell.

2-2-3. Connecting Load cells in Parallel

Some industrial applications require multiple of load cells connected in parallel to configure, for example, a hopper scales or track scale. A typical parallel connection is shown below.

Parallel connection can easily realized using the 4-point multi load cell summing box (e.g. B41X series provided by UNIPULSE).



⚠ CAUTION

Parallel connection of multiple of load cells can drastically change power consumption.

Power supply with sufficient capacity should be selected. See next page for proper evaluation of power requirement.

Seen from F159, the parallel connection of n load cells is considered to be a single load cell with a capacity multiplied by n and the same sensitivity with the constituent load cells.

The averaging resistor (R) takes the value between 300 and 500 Ω, with the same relative ratio and low temperature coefficients. They are not required if the load cell is specifically designed for parallel connection application.

Request

If you connect multiple of load cells in parallel, use load cells with extra capacity margin. Biased loading or mechanical shock may result in overload in some of the cells.

2-2-3-1. Power consumption evaluations for parallel connection

Power consumed by a F159 can vary depending on the number of load cells connected in parallel. For an each additional 350Ω load cell, power requirement will increase by approx.0.13 A.

Number of 350Ω load cells connected in parallel	Power consumption [A]
1	0.30
2	0.43
3	0.56
4	0.69

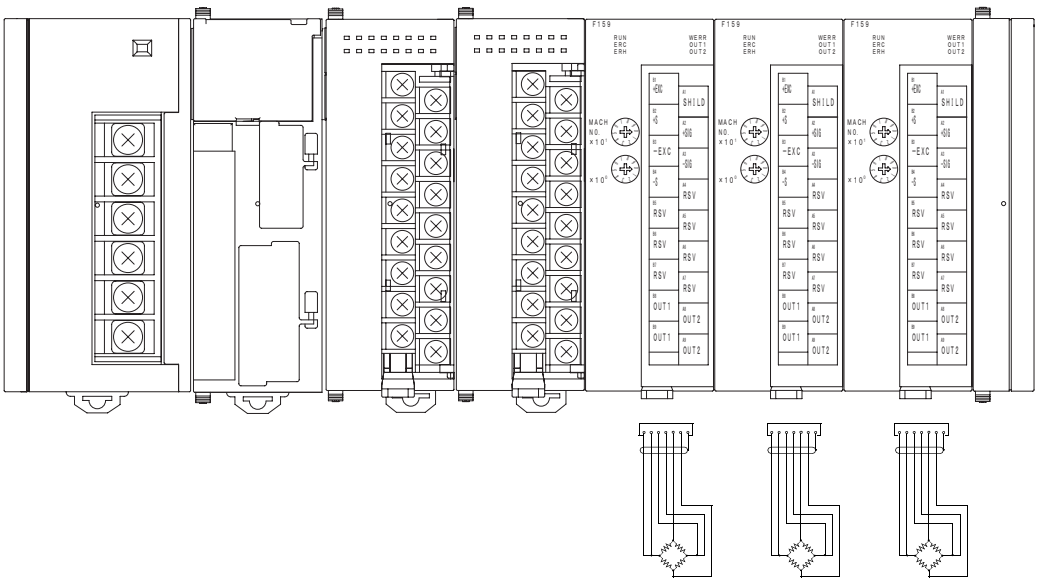
The system must be so designed that it can provide enough power to drive the whole system including F159 and CJ series units (CPU and I/O units). Select a power unit with ample capacity.
Depending on the specification of CJ series device used, up to ten units can be connected to a F159.
(Some CPU units allow expanded installation up to 40 units)

Request

For details on the power requirement of CJ series units, see “OMRON CJ Series: CJ1/CJ1-H/CJ1M CPU Unit User’s Manual (Setup)” provided by OMRON.

<Connection of single 350Ω load cell>

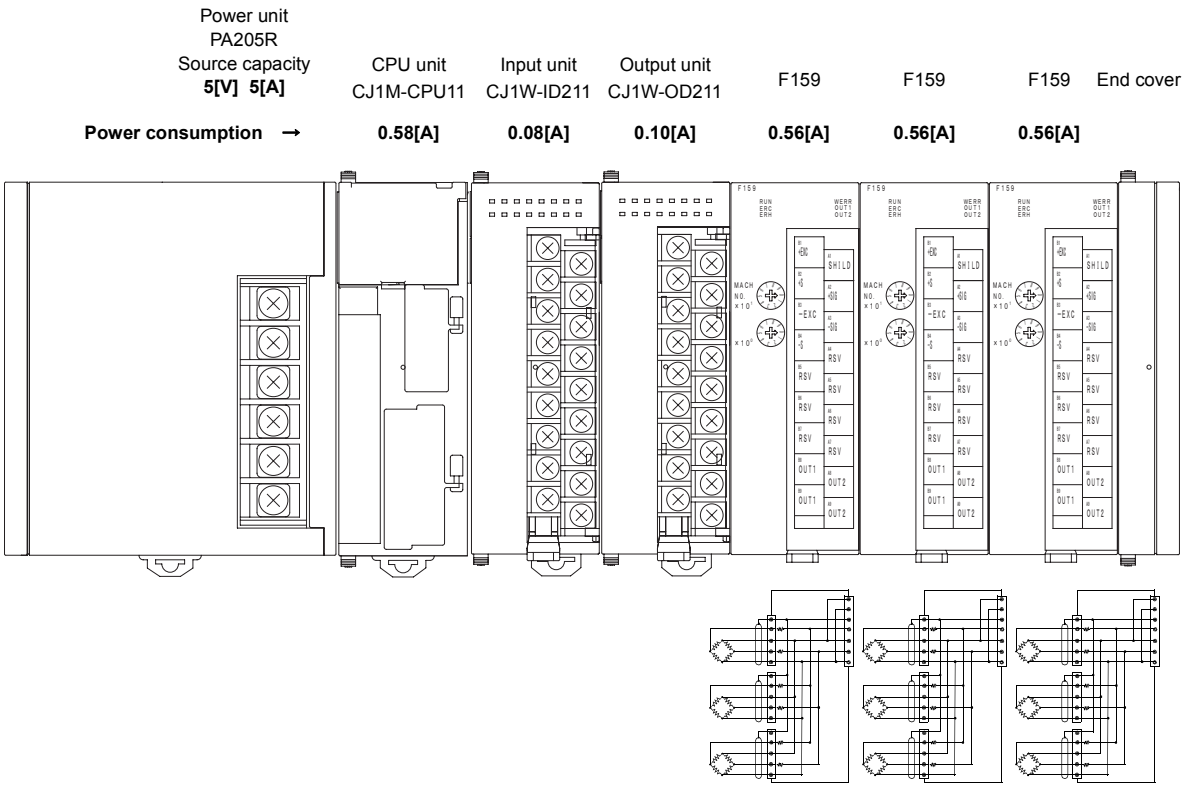
Power unit PA202 Source capacity **5[V] 2.8[A]**	CPU unit CJ1M-CPU11	Input unit CJ1W-ID211	Output unit CJ1W-OD211	F159	F159	F159	End cover
Power consumption →	**0.58[A]**	**0.08[A]**	**0.10[A]**	**0.30[A]**	**0.30[A]**	**0.30[A]**	



Single load cell connection

Unit type	Unit name	Qty	Power consumption (A)
CPU unit	CJ1M-CPU11	1	0.58A
Input unit	CJ1W-ID211	1	0.08A
Output unit	CJ1W-OD211	1	0.10A
Weight Module	F159	3	0.90A
Consumption（A）	Calculation		0.58 ＋ 008 ＋ 0.10 ＋ 0.90
	Result		1.66A（≦ 2.8A）

<Connection of three 350Ω load cells in parallel>



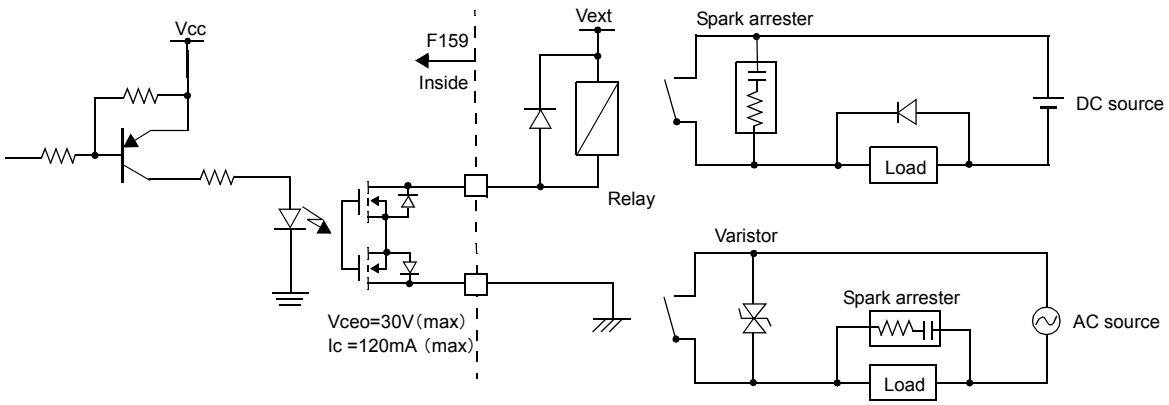
Three load cells are connected in parallel

Unit type	Unit name	Qty	Power consumption (A)
CPU unit	CJ1M-CPU11	1	0.58A
Input unit	CJ1W-ID211	1	0.08A
Output unit	CJ1W-OD211	1	0.10A
Weight Module	F159	3	1.68A
Consumption（A）	Calculation		0.58 ＋ 008 ＋ 0.10 ＋ 1.68
	Result		2.44A（≦ 5A）

2-3. Output Connection

2-3-1. Equivalent Circuit

F159 uses non-polar MOS FET relays for signal output.



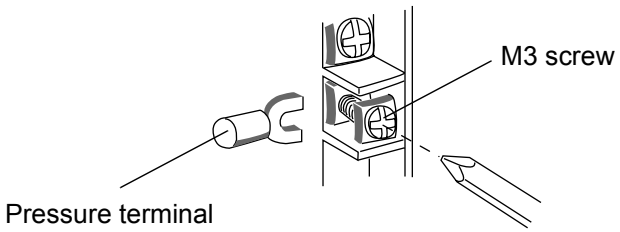
Output data	MOS FET relay
0	OFF
1	ON

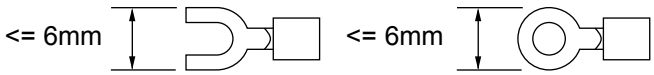
- User must provide an external power unit (Vext <= 30 VDC) to drive the output relay.
- Do not short circuit the load (such as a relay coil). This may damage the output relay.
- Use surge absorbing devices appropriately in the relay circuit (see the diagram above) to suppress surge voltage from occurring. These devices are effective to reduce noise-related problems and to extend the relay life.

2-4. Connections to Terminal Block

Use pressure terminals to connect cables to the terminal. Tighten the pressure terminal securely to the terminal block using a M3 screw. Correct tightening torque is 0.5Nm.

The width of the pressure terminal should be 6mm or less (see the figure below).





Request

Input and output signal lines should be routed separately from noisy power lines and AC lines.

3. DATA EXCHANGE WITH CPU

The F159 exchanges data with CPU using the following devices: High performance I/O unit relay area (weight and status data) and high performance I/O unit DM area (weighing setting and initial setting data).

Weight data

Analog signal from the load cell is converted into digital weight data.
Weight data is allocated to one of the relay area of the CPU units' high performance I/O unit based upon the unit number. The data is exchanged regularly every time I/O refresh takes place.

Status data

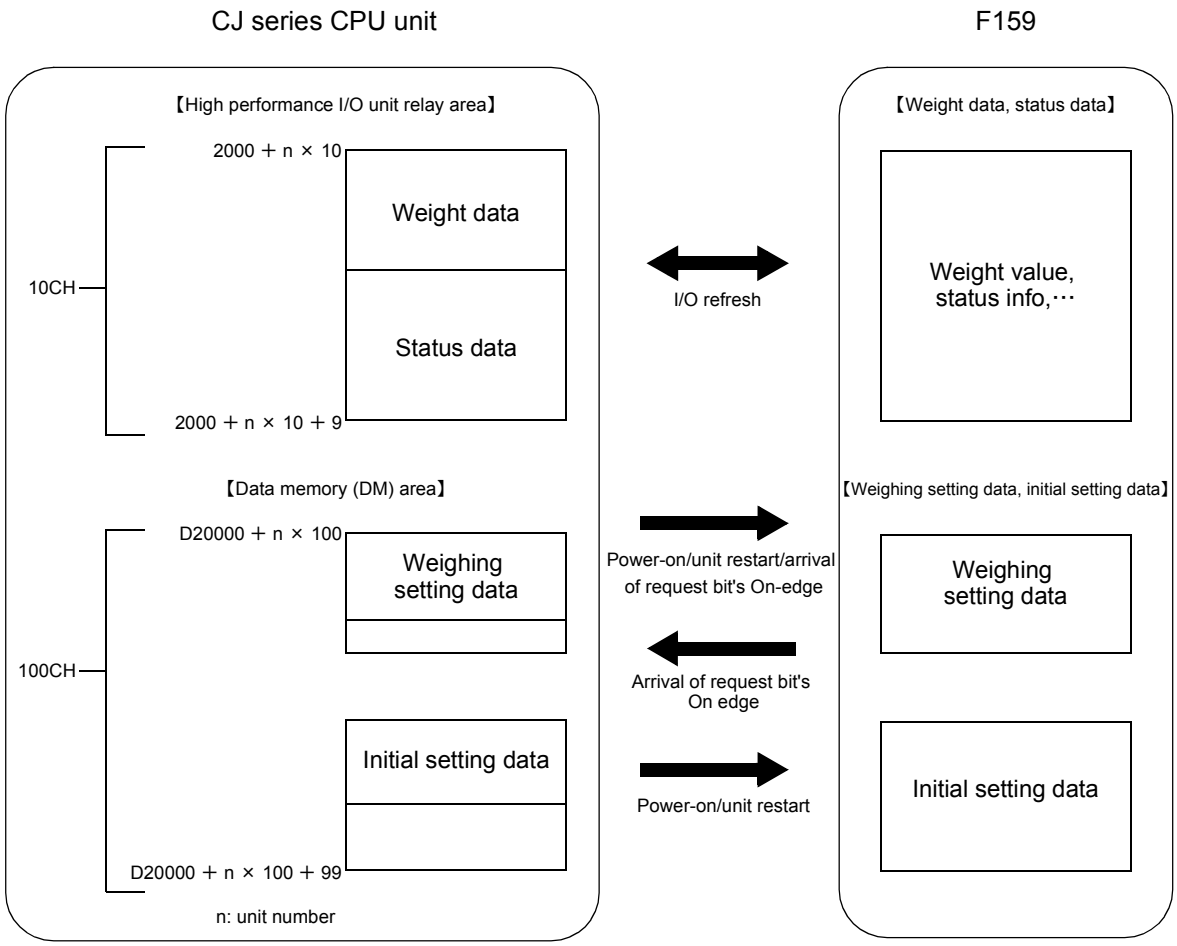
Status data includes various status and error information.
Status data is allocated to one of the relay areas of the high performance I/O unit in the CPU unit based on the unit number. The data is exchanged regularly every time I/O refresh takes place.

Weighing setting data

Settings for performing weight measurement.
One F159 is allocated, based on its unit number, to a selected DM area for high performance I/O unit (inside CPU unit). Data is written to the DM area in synchronization with: power-on, refresh start, and request bit (On-edge). Data is also read out using the request bit's On-edge: the bit can be used both for reading and writing depending on R/W bit status.

Initial setting data

Parameter settings for using F159 as a Weight Module.
A set of initial setting data for each F159 is allocated, based on its unit number, to a DM area for high performance I/O unit (inside CPU unit), and is written to this area when the unit is powered on, or a refresh cycle is started.



3-1. High Performance I/O Unit Restart Flag

When the user restart the unit after he has modified data memory or removed the cause of failure, the user have to either power up the CJ1 main unit again, or changing the high performance I/O unit restart flag in the following sequence: OFF → ON → OFF.

High performance I/O unit restart flag

Relay number	Function	
A50200	0th unit restart flag	Restart each unit by switching OFF → ON → OFF
A50201	1th unit restart flag	
≀	≀	
A50215	15th unit restart flag	
A50300	16th unit restart flag	
≀	≀	
A50715	95th unit restart flag	

3-2. Relay Area

3-2-1. Allocation of Weight and Status Data

OUT (CPU unit → F159)

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
n CH			Soft LOCK		SEQ STOP	SEQ START	Judge	FF CPS.		Feed/ Discharge	Digital tare subtraction	HOLD	DZ OFF	DZ ON	TARE OFF	TARE ON
n+1 CH		R/W		Request											Span calibration	Zero calibration

IN （F159 → CPU unit）

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
n+2 CH	Gross weight 10^3				Gross weight 10^2				Gross weight 10^1				Gross weight 10^0			
	8	4	2	1	8	4	2	1	8	4	2	1	8	4	2	1
n+3 CH	Over	Go	Under	Com-plete	SP3	SP2	SP1	Near zero	Decimal place		Gross weight sign		Gross weight 10^4			
									2	1			8	4	2	1
n+4 CH	Net weight 10^3				Net weight 10^2				Net weight 10^1				Net weight 10^0			
	8	4	2	1	8	4	2	1	8	4	2	1	8	4	2	1
n+5 CH	Feed/ Discharge	Tare subtraction in progress	HOLD in progress	ZT in progress	CZ	Stable	Upper limit	Lower limit	Decimal place		Net weight sign		Net weight 10^4			
									2	1			8	4	2	1
n+6 CH		Normally ON	ERR ON	Cyclic bit						NOV RAM	Span calibration in progress	Zero calibration in progress	DIP SW			
													4	3	2	1
n+7 CH	Calibration error	EXC ALM	Zero error	OFL3	OFL2	OFL1	+LOAD	-LOAD	Error assistance code				Error code			
									8	4	2	1	8	4	2	1
n+8 CH			Soft LOCK		SEQ STOP	SEQ START	Judge	FF CPS.		Feed/ Discharge	Digital tare subtraction	HOLD	DZ OFF	DZ ON	TARE OFF	TARE ON
n+9 CH		R/W		Request											Span calibration	Zero calibration

n = 2000 + (unit number × 10)

3-2-2. OUT (CPU unit → F159)

TARE ON

ON edge (0 → 1) triggers tare subtraction, nulling the Net weight. Note, however, the user can place some restrictions on tare subtraction (see 5-12. "Restriction on Tare Subtraction"), in which case this function can be activated only when the reading is “Stable”.

The range of tare subtraction is selectable from: whole range, or 0 <= Tare < Capacity.

“Tare subtraction in progress” bit (14th bit of n+5 CH) becomes 1 while this process is underway.

TARE OFF

ON edge (0 → 1) disables tare subtraction function. Set value for tare subtraction remains intact.

DZ ON

ON edge (0 → 1) triggers Digital Zeroing (Gross weight is zero cleared). Allowable range of digital zeroing is within the range set by DZ regulation value. “Zero Error” occurs if the reading is out of this range.

DZ OFF

ON edge (0 → 1) disables Digital Zero function. “Zero Error” message will also be cleared.

HOLD

While this bit is on “1”, Weight Value and Comparison Value remain unchanged (hold).
HOLD bit (13th bit of n+5 CH) remains high while HOLD is activated.

Digital tare subtraction

If “relay” is selected for tare subtraction trigger, this bit determines ON/OFF of Digital tare subtraction function.
1: Digital tare subtraction is ON
0: Digital tare subtraction is OFF

Feed / Discharge

If “relay” is selected in Weighing mode setting, this bit determines ON/OFF of Feed/Discharge switching.
1: Discharge control
0: Feed control

FF CPS.

If “relay” is selected in FF CPS. setting, this bit determines ON/OFF of FF CPS..
1: FF CPS. ON
0: FF CPS. OFF

Judge

This bit is used for two purposes:
If Over/Under decision is to be triggered by Judge input, this signal triggers Over/Under judgment.
If Upper/Lower limit decision is to be triggered by Judge input, this signal triggers Upper/Lower limit judgment.
1: Judgment ON
0: Judgment OFF

SEQ START

If Sequence mode is selected in Mode selection, ON edge (0 → 1) in this signal starts a new sequence.

SEQ STOP

While sequence control is underway, ON edge (0 → 1) in this signal will abort the control sequence resulting in "Sequence error 2" (Error assistance code =3, Error code =2).
While the system is in the state of sequence error (Error assistance code =3), ON edge (0 → 1) in this signal resets the sequence error.

Soft LOCK

Soft LOCK enables/disables setting modification for Zero calibration and Span calibration. If Soft LOCK is set to "1", any attempt to change current settings for Zero/Span calibration is inhibited.
Therefore, user must set this bit to "0" before trying to alter calibration settings.

Zero calibration

ON edge (0→1) in this signal initiates Zero calibration. Note, however, this input is ignored when "Soft LOCK" is set to "1", "LOCK SW"(DIP switch) is ON, or a preceding calibration process is still underway.

Span calibration

ON edge (0 → 1) in this signal initiates Span calibration. Note, however, this input is ignored when "Soft LOCK" is set to "1", "LOCK SW"(DIP switch) is ON, or a preceding calibration process is still underway.

Request

ON edge (0 → 1) in this signal triggers F159 to exchange the set of weighing settings (m – m+19 CH in DM area) with CPU unit. Direction of data transfer (CPU → F159, or F159 → CPU) is determined by R/W bit.

R/W

The state of this line (1/0) at the time of REQUEST trigger (0 → 1) determines the direction of data transfer between F159 and CPU.

1: Write (CPU unit → F159)

0：Read （F159 → CPU unit）

3-2-3. IN (F159 → CPU unit)

Gross weight 10^0 - 10^4

Indicates Gross weight.

Gross weight sign

"1" when Gross weight becomes negative

Decimal place

Indicates the position of decimal point.

2	1	Decimal place
OFF	OFF	0
OFF	ON	0.0
ON	OFF	0.00
ON	ON	0.000

Near zero

"1" when weight <= Near zero setting.

Weight : weight value Near zero

SP1, SP2, SP3

Simple comparison mode

SP1: "1" if weight >= Final setting – Set point 1 setting

SP2: "1" if weight >= Final setting – Set point 2 setting

SP3: "1" if weight >= Final setting – FF CPS.setting

Sequence mode

Each bit is initialized to "1" when weighing sequence is started by SEQ Start's ON edge.

SP1: "0" if weight >= Final setting – Set point 1 setting

SP2: "0" if weight >= Final setting – Set point 2 setting

SP3: "0" if weight >= Final setting – FF CPS.setting

Weight: weight for Over/Under comparison

Complete

Simple comparison mode

Timing of Complete bit output is determined by the selection made in Weighing function 2 (Complete signal output mode). Time duration for which this signal is held "1" depends on the setting in complete signal output.

Sequence mode

Over/Under judgment enabled:

Criteria: Other than "Comparison OFF", and non-zero Judging times have been selected for Over/Under comparison.

Timing of Complete bit output is determined by the selection made in Weighing function 2 (Complete signal output mode). Time duration for which this signal is held "1" depends on the setting in complete signal output.

Over/Under judgment disabled:

Criteria: Judging times is set to "0" (Over/Under judgment OFF)

Complete bit becomes "1" if SP3 goes low (OFF edge, 1 → 0) ignoring the setting in the complete signal output mode (Weighing function 2).
Time duration for which this signal is held "1" depends on the setting in complete signal output.

- After an Complete signal output, weight value must fall below the 25% level of Final setting. Otherwise, Complete for next run cannot change to "1".
- If the value for Final is set to "0", Complete may spontaneously change to "1" when the F159 is powered.

Under, Go, Over

Simple comparison mode

Judgment criteria is selected in Over/Under comparison mode (Weighing function 2)

Under: "1" if Weight < Final setting – Under setting

Over: "1" if Weight > Final setting + Over setting

Go: "1" if Final setting + Over setting >= Weight >= Final setting – FF CPS. setting

Sequence mode

Judgment is carried out when Complete bit is ON, irrespective of Over/Under comparison mode (Weighing function 2) settings. Weight value will be frozen (if judgment is enabled).

Under: "1" if Weight < Final setting – Under setting

Over: "1" if Weight > Final setting + Over setting

Go: "1" if Final setting + Over setting >= Weight >= Final setting – FF CPS. setting

Net weight 10^0 - 10^4

Indicates Net weight

Net weight sign

"1" when Net weight becomes negative

Upper/Lower limit

Timing of judgment is selected in Upper/Lower limit comparison mode: continuous comparison, or comparison synchronized with Judge input. The latter case requires Judge bit to be "1".

Lower limit: "1" if Weight < Lower limit setting

Upper limit: "1" if Weight > Upper limit setting

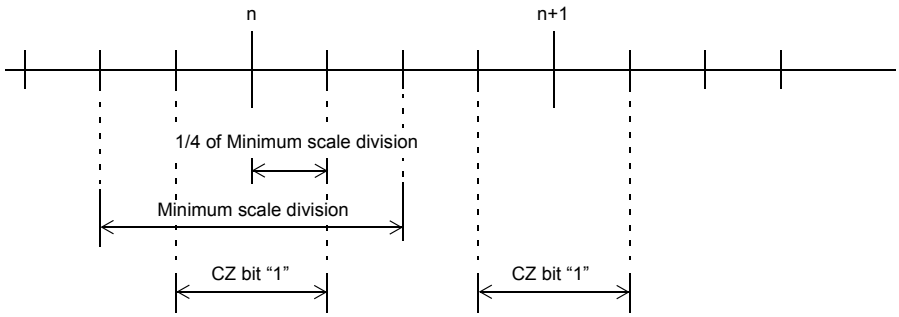
Stable

This bit turns "1" when weight value comes stabilized.

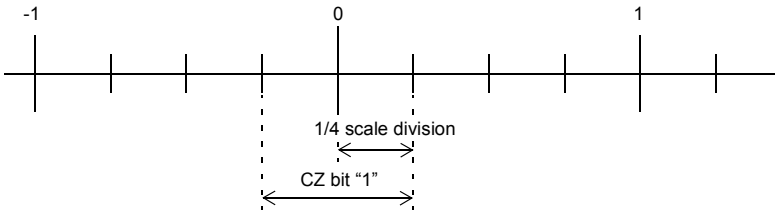
* For more information, see Section 5-4. "Motion Detection (MD)" , page52.

CZ

CZ (Center Zero) bit helps the user find out the center of scale interval. The Minimum scale division is divided into four sub-divisions, and CZ bit becomes "1" if reading falls within the central two sub-divisions.



When 1/4 scale division is disabled, CZ becomes "1" only if reading coincides with true zero point.



ZT in progress

ZT in Progress bit becomes "1" when Zero tracking is enabled.

* For more information, see Section 5-5. "Zero Tracking (ZT)" , page54.

HOLD in progress

HOLD in Progress bit becomes "1" while weight value is frozen.

Tare subtraction in progress

This bit becomes "1" while tare subtraction function is enables (Tare must have non zero value).

Feed / Discharge

This bit becomes “1” when Feed control is enabled, and “0” when Discharge control is enabled. This selection is made in Weighing mode.

DIP SW 1 - 4

These bits indicate the status of DIP switch selections.
A “1” in these bits indicates that the corresponding switch is ON, and a “0” indicates that the switch is OFF.

Zero calibration in progress

This bit becomes “1” while Zero calibration is in progress.

Span calibration in progress

This bit becomes “1” while Span calibration is in progress.

NOV RAM

This bit becomes “1” when NOV RAM is being accessed.
Do not remove power from F159 while this bit is “1”.

Cyclic bit

This bit toggles between “1” and “0” in approx. one second interval.

ERR ON

This bit becomes “1” if there are one more unresolved errors (non-zero error code).

Normally ON

This bit is always “1”.

Error code

Combination of this bit and Error Assistance Code bit identify the nature of the error. Error Code “0” indicates that the system is currently error free.

Error assistance code

Combination of this bit and Error Code bit identify the nature of the error. Error Assistance Code “0” indicates that the system is currently error free.

For detailed information about Error Code and Error Assistance Code, see Section 9-1. "Error Code and Error Assistance Code" , page97.

-LOAD

This bit is set “1” when input signal from the load cell overshoots to negative range.

+LOAD

This bit is set “1” when input signal from the load cell overshoots to positive range.

OFL1

This bit is set “1” when Net Weight > Net Over setting.

OFL2

This bit is set “1” when Gross weight > Capacity + 9 scale intervals.

OFL3

This bit is set “1” when Gross weight > Gross Over setting.

Zero error

Performing zero-clear operation (Digital Zero or Zero tracking) when reading is over the Digital Zero regulation value produce Zero Error, raising this bit.
To remove this error and reset Zero Error bit, perform Digital Zero Reset of Zero calibration.

EXC ALM

This bit changes to “1” when the load cell excitation voltage falls below the scecified level.

Calibration error

This bit turns on “1” when one or more irregularities were found during zero/ Span calibration and the process did not complete normally.

TARE ON response

Returns the state of TARE ON bit.

TARE OFF response

Returns the state of TARE OFF bit.

DZ ON response

Returns the state of DZ ON bit.

DZ OFF response

Returns the state of DZ OFF bit.

HOLD response

Returns the state of HOLD bit.

Digital tare subtraction response

Returns the state of Digital tare subtraction bit.

Feed / Discharge response

Return the state of Feed/Discharge bit.

Free fall compensation response

Returns the state of FF CPS. bit.

Judge response

Returns the state of Judge bit.

SEQ START response

Returns the state of SEQ START bit.

SEQ STOP response

Returns the state of SEQ STOP bit.

Soft LOCK response

Return the state of Soft LOCK bit.

Zero calibration response

Returns the state of Zero Calibration bit.

Span calibration response

Return the state of Span calibration bit.

Request response

Returns the state of REQUEST bit.

R/W response

Returns the state of R/W bit.

3-2-4. Register Allocations for Weighing Control

m	10^3	10^2	10^1	10^0	Upper limit	00000 - 99999
m+1				10^4		
m+2	10^3	10^2	10^1	10^0	Lower limit	00000 - 99999
m+3				10^4		
m+4	10^3	10^2	10^1	10^0	Near zero	00000 - 99999
m+5				10^4		
m+6	10^3	10^2	10^1	10^0	Set point 1	00000 - 99999
m+7				10^4		
m+8	10^3	10^2	10^1	10^0	Set point 2	00000 - 99999
m+9				10^4		
m+10	10^3	10^2	10^1	10^0	Free fall compensation	0000 - 9999
m+11		10^2	10^1	10^0	Over	000 - 999
m+12		10^2	10^1	10^0	Under	000 - 999
m+13	10^3	10^2	10^1	10^0	Final	00000 - 99999
m+14				10^4		
m+15	10^3	10^2	10^1	10^0	Preset tare value	00000 - 99999
m+16				10^4		
m+17					Undefined	
m+18					Undefined	
m+19					Undefined	

m = D20000 + Unit No. × 100

3-2-5. Register Allocations for Initial Settings

m+20		10^0	10^{-1}	10^{-2}	Comparison inhibit time	0.00 - 9.99
m+21		10^0	10^{-1}	10^{-2}	Compare time	0.00 - 9.99
m+22		10^0	10^{-1}	10^{-2}	Complete output time	0.00 - 9.99
m+23		10^0	10^{-1}	10^{-2}	Auto jog timer	0.00 - 9.99
m+24	10^1	10^0	10^1	10^0	Auto zero times/ Judging times	
m+25	10^3	10^2	10^1	10^0	FF CPS. regulation	00000 - 99999
m+26				10^4		
m+27	10^0	10^0	10^0	10^0	Weighing function 1	
m+28	10^0	10^0	10^0	10^0	Weighing function 2	
m+29	10^0	10^0	10^0	10^0	Weighing function 3	
m+30			10^0	10^0	Output selection	
m+31	10^0	10^0	10^0	10^0	Restriction on the tare subtraction	
m+32	10^0	10^0	10^0	10^0	Sequence mode	
m+33	10^0	10^{-1}	10^1	10^0	Motion detection	
m+34			10^0	10^{-1}	Zero tracking (Period)	0.0 - 9.9
m+35	10^3	10^2	10^1	10^0	Zero tracking (Range)	0000 - 9999
m+36	10^0	10^2	10^1	10^0	Filter	
m+37			10^0	10^0	Stable mode	
m+38			10^0	10^0	Function selection	
m+39	10^3	10^2	10^1	10^0	Balance weight value	00000 - 99999
m+40				10^4		
m+41	10^3	10^2	10^1	10^0	Capacity	00000 - 99999
m+42				10^4		
m+43		10^2	10^1	10^0	Minimum scale division	000 - 100
m+44	10^3	10^2	10^1	10^0	Net Over	00000 - 99999
m+45				10^4		
m+46	10^3	10^2	10^1	10^0	Gross Over	00000 - 99999
m+47				10^4		
m+48	10^3	10^2	10^1	10^0	DZ regulation value	00000 - 99999
m+49				10^4		
m+50			10^1	10^0	Gravitational acceleration (Area number input)	00 - 16
m+51	10^0	10^{-1}	10^{-2}	10^{-3}	Gravitational acceleration (Acceleration input)	9.700 - 9.999
m+52					Undefined	
m+53					Undefined	
⋮						
m+99					Undefined	

m = D20000 + Unit No. × 100

F159 and CPU unit exchange data in BCD format.

Example: How to set “7500” to Upper limit

	10^3	10^2	10^1	10^0
m				
m+1				10^4

m	7	5	0	0
m+1	0	0	0	0

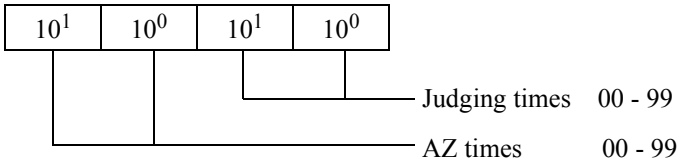
	10^3				10^2				10^1				10^0			
	8	4	2	1	8	4	2	1	8	4	2	1	8	4	2	1
m																
m+1	Undefined				Undefined				Undefined				10^4			
													8	4	2	1

m	0	1	1	1	0	1	0	1	0	0	0	0	0	0	0	0
m+1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

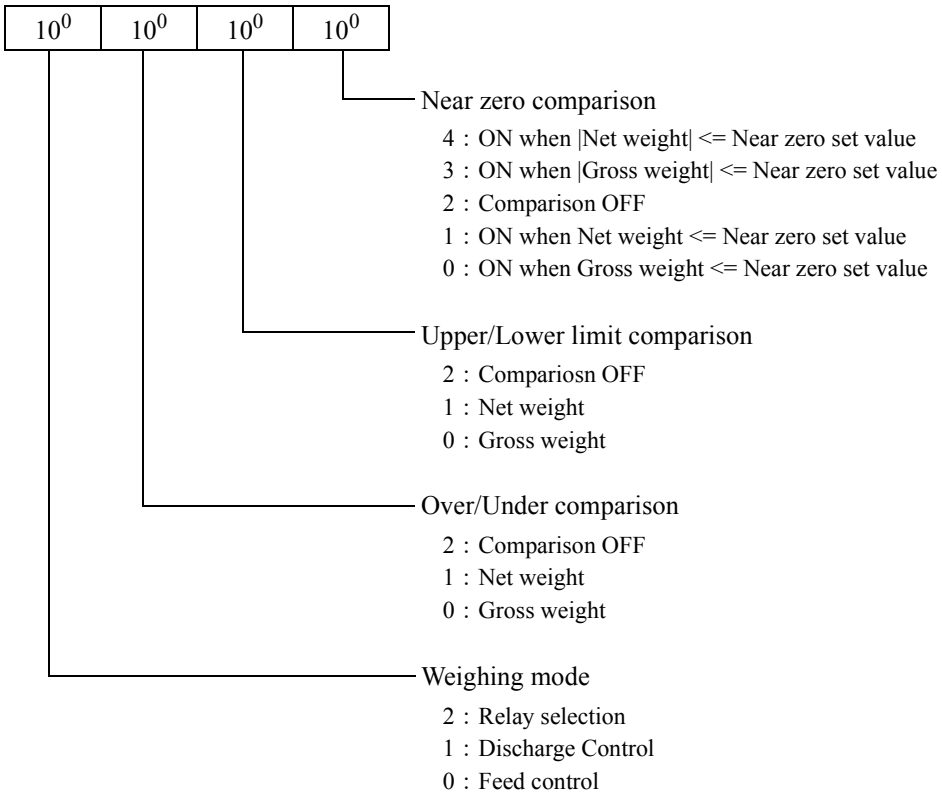
⚠ CAUTION

F159 and CPU unit exchange data in BCD format. Violation of this rule will cause an unexpected operational failure. Data in “undefined” area is ignored: it is strongly recommended that these areas are filled up with “0”s.

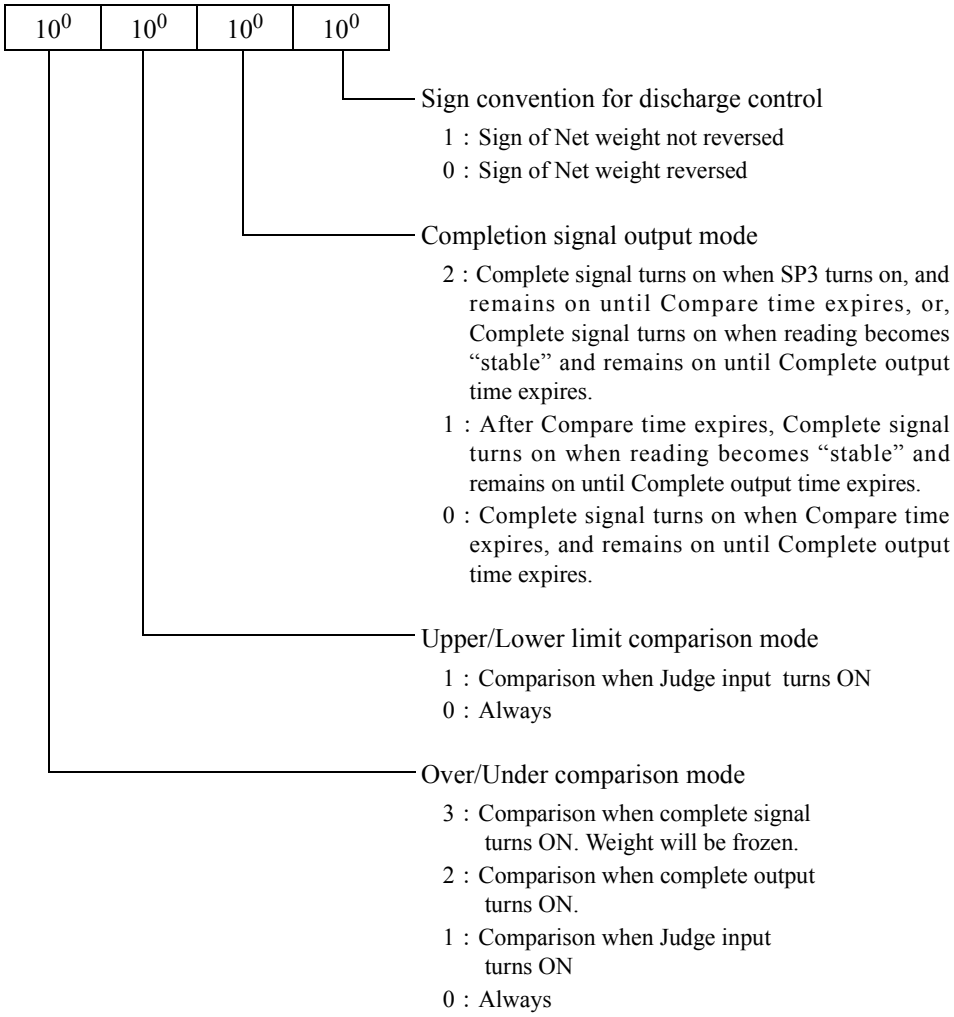
Auto zero times /Judging times



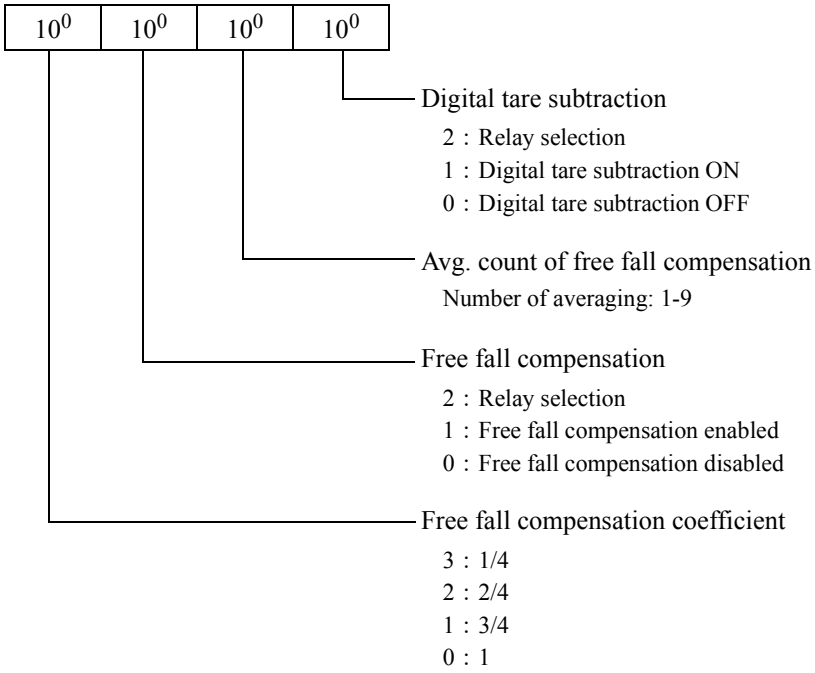
Weighing function 1



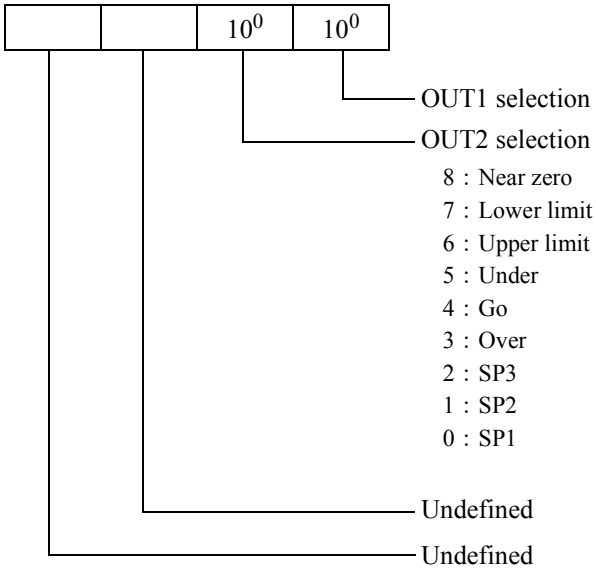
Weighing function 2



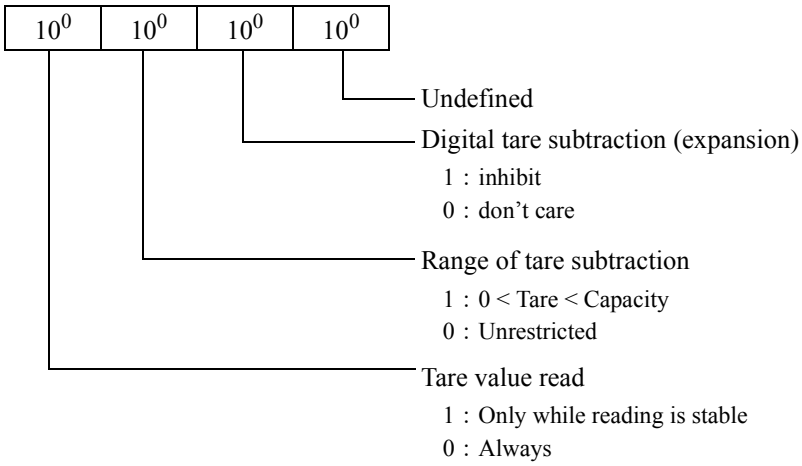
Weighing function 3



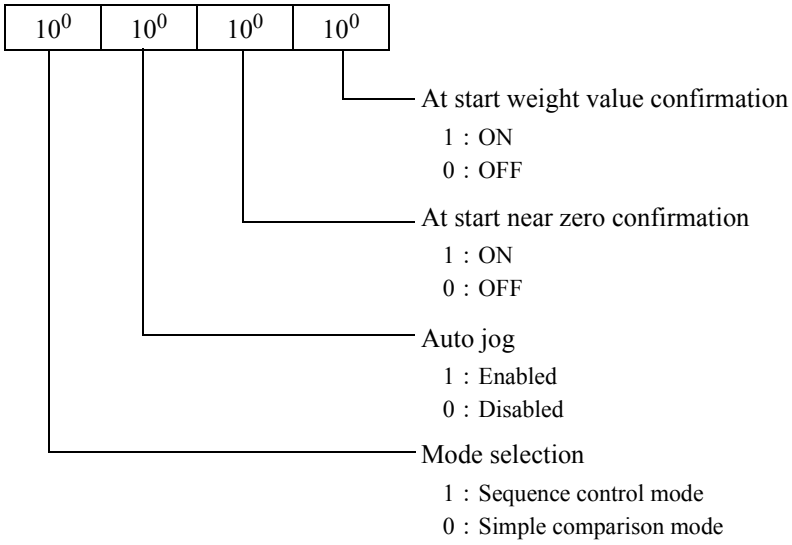
Output selection



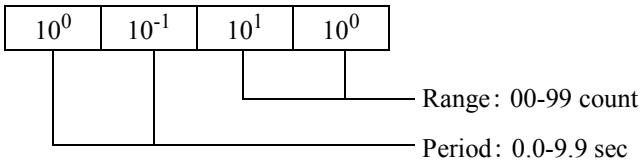
Restriction on the tare subtraction



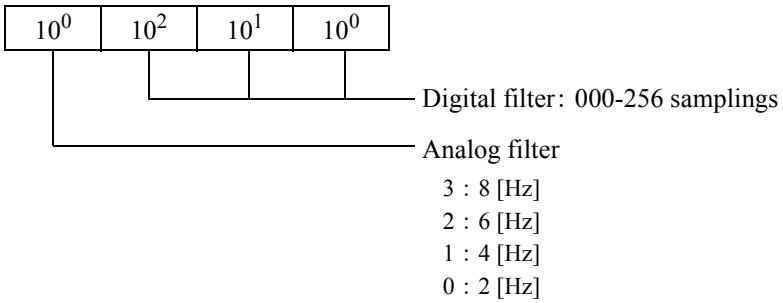
Sequence mode



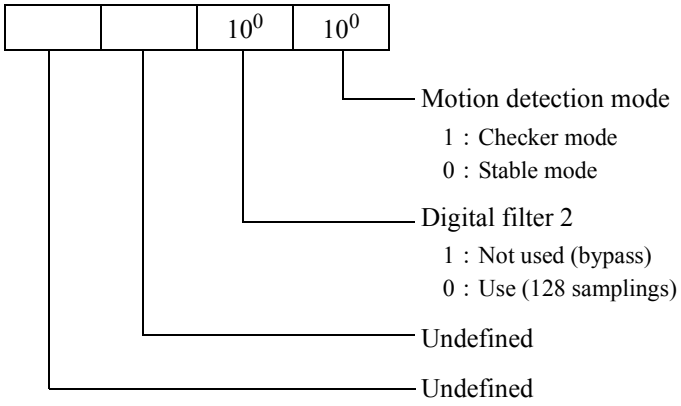
Motion detection



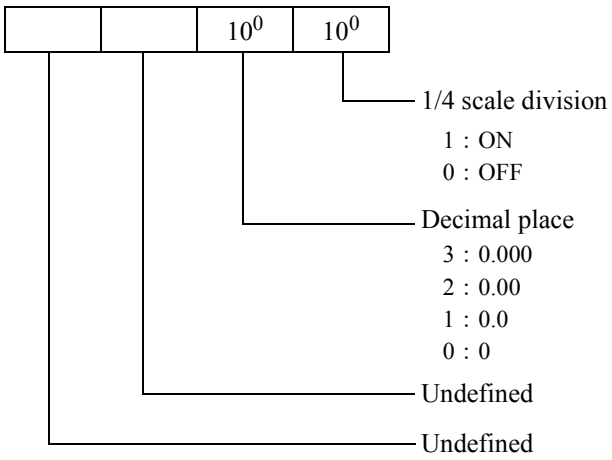
Filer



Stable mode



Function selection

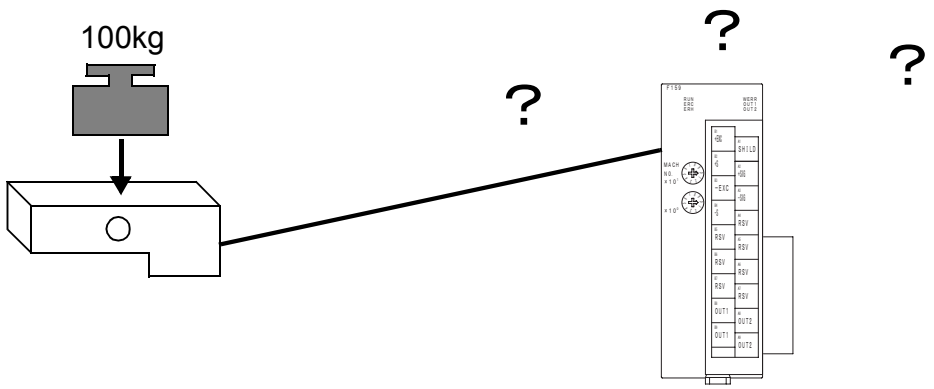


4. CALIBRATION

4-1. What is Calibration?

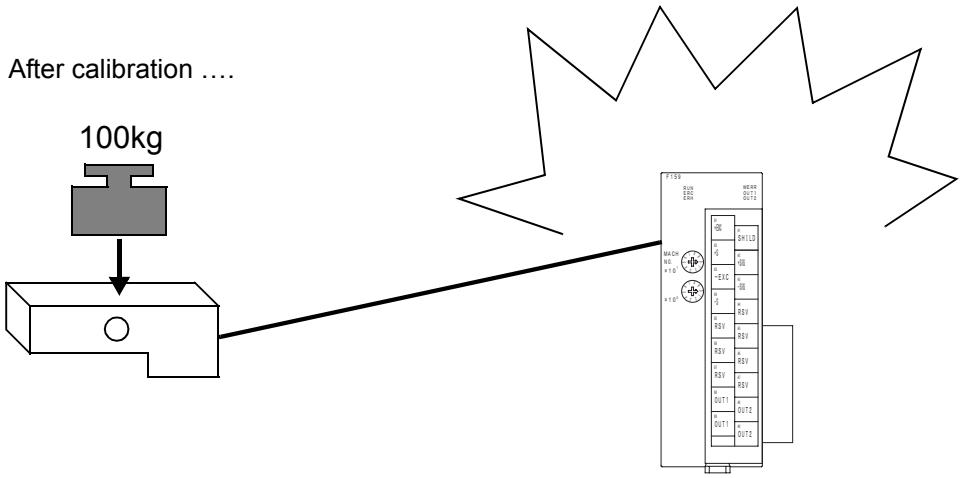
Calibration designates a procedure to adjust F159 so that it indicates correct reading corresponding to the actual weight placed on the load cell. That is, F159 must be properly adjusted to indicate 100 kg when an actual load (weight) of 100 kg is placed on the load cell (sensing device). This process is called an actual loading calibration.

Just connecting an load cell to F159…



F159 indicates random values

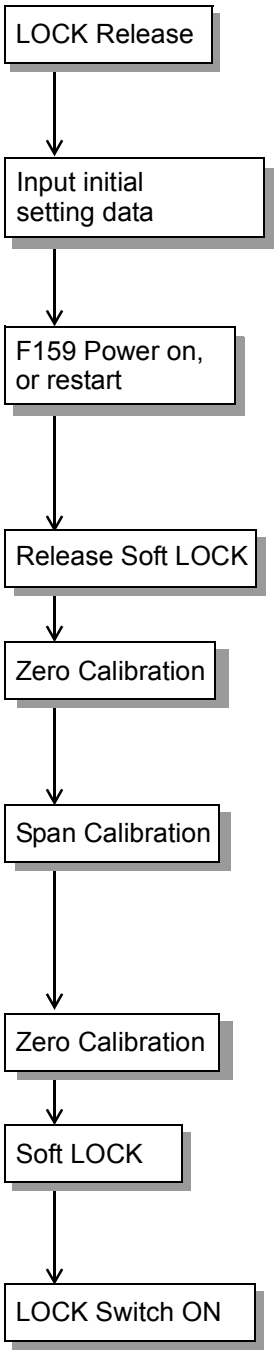
After calibration ….



F159 and the load cell constitute
a well-tuned metering system

4-2. Actual Load Calibration Procedure

Steps required to perform actual load calibration are as follows:



Toggle the DIP switch 1 to OFF position (the switch is located under the terminal block).

Write initial setting data to the DM area that corresponds to MACH No.

Register initial setting data to F159. To do this, either power on the F159, or restart it by toggling restart flag in the following sequence: OFF → ON → OFF.

Set Soft LOCK bit (13th bit of n CH) to "0".

Register initial zero value by setting the Zero calibration bit (0th bit of n+1 CH) to "1".

Register span value by loading the cell with actual span load and setting the Zero calibration bit (0th bit of n+1 CH) to "1"

Perform the Zero calibration procedure again if required.

Inhibit calibration procedures to avoid unauthorized or accidental alteration.

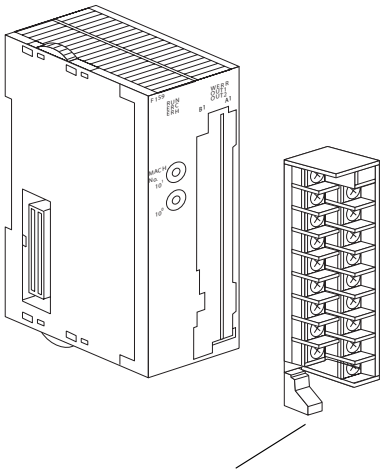
Toggle the LOCK switch to ON position to avoid unauthorized or accidental modification of calibration. Removal of the terminal block is required for this operation: make sure that NOV RAM bit (6th bit of n+6 CH) is in "0" position and power off the F159 before trying to detach the terminal block.

4-3. Preparation for Calibration

4-3-1. LOCK Release

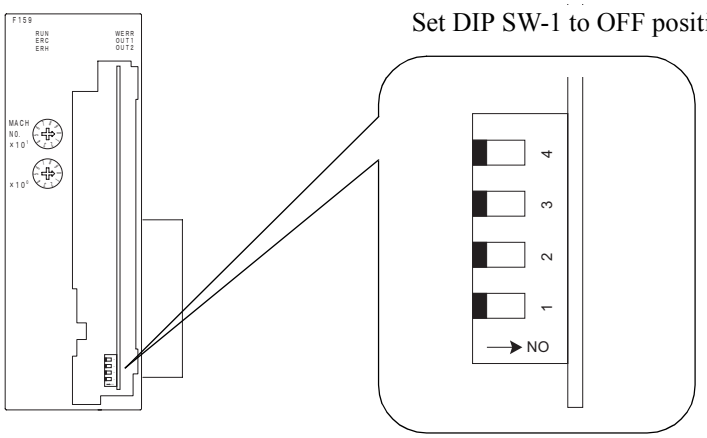
F159 provides two types of LOCK features to avoid unauthorized or accidental alteration of calibration and setting values. The Soft LOCK is enabled by setting a bit in a register, and hardware LOCK is activated by setting a DIP switch. The user must disable both of the LOCK features before trying to perform calibration procedures.

1.Remove the terminal block
(F159 must be turned off before terminal block removal)



Pulling down the lever releases the terminal block

2.Set DIP switch 1 to OFF position



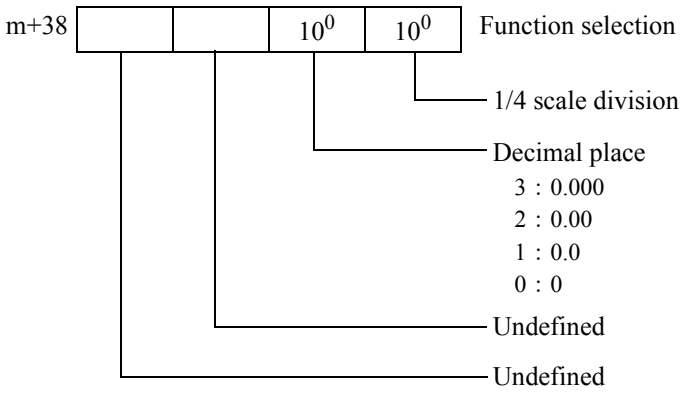
3.Turn on F159 and set Soft LOCK bit (13th bit of n CH) to “0”.

4-3-2. Setting Initial Data

Minimum data items required for performing proper calibration are: Decimal place, Balance weight value, Capacity, and Minimum scale division. Initial setting data are registered when F159 is powered on or it restarts.

Decimal place

Decimal place specifies numerical format used for reading display and setting parameters. The format can be selected from 0, 0.0, 0.00, 0.000.



Balance weight value

Specify weight value for Span calibration (Input range: 0 – 99999)

m+39	10^3	10^2	10^1	10^0	Balance weight value
m+40				10^4	

Capacity

Defines maximum allowable weight that can be measured by the system (Input range: 0 – 99999). “OFL2” error occurs if actual weight exceeds this value by nine scale divisions.

m+41	10^3	10^2	10^1	10^0	Capacity
m+42				10^4	

Minimum scale division

Defines the Minimum scale division or scale interval (Input range: 1 – 100)

m+43		10^2	10^1	10^0	Minimum scale division

Gravitational acceleration

This factor compensates regional difference in Gravitational acceleration. This factor needs not be specified if the system is used in the same area where actual load calibration took place.

Two methods are provided to enter correct Gravitational acceleration: One method uses area numbers and the other requires direct input of Gravitational acceleration value.

In the former method, the user enters a area number (01-16) from the GA correction table for the region where actual load calibration will take place, and then select a area number corresponding to the region where the system is installed. Correct Gravitational acceleration compensation will be performed using these two area numbers.

The latter method, direct input of Gravitational acceleration, is selected by specifying area number “00”.

Input range:

Area number: 00-16

Gravitational acceleration: 9.700-9.999

m+50			10^1	10^0	Area number
m+51	10^0	10^{-1}	10^{-2}	10^{-3}	Gravitational acceleration

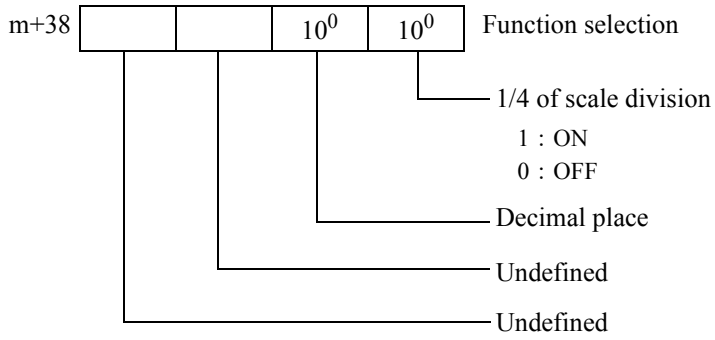
Gravitational acceleration

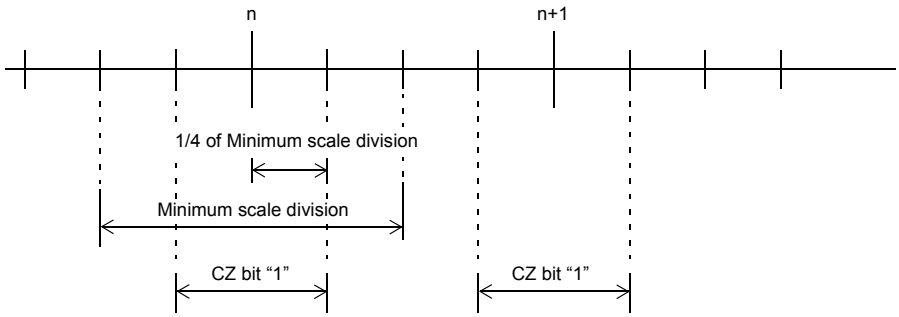
01	9.806	02	9.805	03	9.804	04	9.803
05	9.802	06	9.801	07	9.800	08	9.799
09	9.798	10	9.797	11	9.796	12	9.795
13	9.794	14	9.793	15	9.792	16	9.791

Amsterdam	9.813m/s^2	Ottawa	9.806m/s^2
Athens	9.800m/s^2	Paris	9.809m/s^2
Auckland NZ	9.799m/s^2	Rio de janeiro	9.788m/s^2
Bangkok	9.783m/s^2	Rome	9.803m/s^2
Birmingham	9.813m/s^2	San Francisco	9.800m/s^2
Brusseles	9.811m/s^2	Singapore	9.781m/s^2
Buenos Aires	9.797m/s^2	Stockholm	9.818m/s^2
Calcutta	9.788m/s^2	Sydney	9.797m/s^2
Capetown	9.796m/s^2	Taichung	9.789m/s^2
Chicago	9.803m/s^2	Taiwan	9.788m/s^2
Copenhagen	9.815m/s^2	Taipei	9.790m/s^2
Cyprus	9.797m/s^2	Tokyo	9.798m/s^2
Djakarta	9.781m/s^2	Vancouver,BC	9.809m/s^2
Frankfurt	9.810m/s^2	Washinton DC	9.801m/s^2
Glasgow	9.816m/s^2	Wellington NZ	9.803m/s^2
Havana	9.788m/s^2	Zurich	9.807m/s^2
Helsinki	9.819m/s^2		
Kuwait	9.793m/s^2		
Lisbon	9.801m/s^2		
London (Greenwich)	9.812m/s^2		
Los Angelse	9.796m/s^2		
Madrid	9.800m/s^2		
Manila	9.784m/s^2		
Melbourne	9.800m/s^2		
Mexico City	9.779m/s^2		
Milan	9.806m/s^2		
New York	9.802m/s^2		
Oslo	9.819m/s^2		

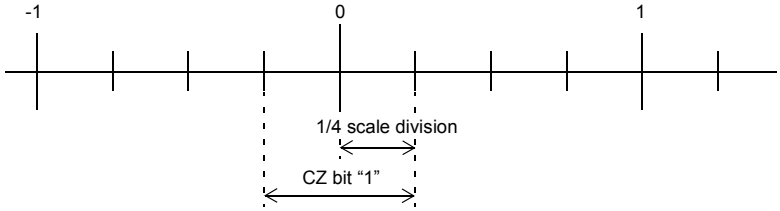
1/4 Scale Division

This function facilitates finding the central portion within the Minimum scale division. If this function is enabled, the width of Minimum scale division is further divided into four equal width portions. If reading falls within the central two portions, CZ bit (11th bit of n+5 CH) will be set to "1". This function can be enabled/disabled by the user.





When 1/4 scale division is disabled, CZ becomes "1" only if reading coincides with true zero point.



4-4. Zero Calibration

Follow the steps below to define correct initial value:

1. Make sure that the load cell (sensing device) is free from unnecessary load, such as foreign object placed on the weighing plate, or contact with peripheral devices.

2. Make sure that the “stable” bit (10th bit of n+5 CH) is set to “1”.
   (Calibration procedures must be performed while reading is stable)

3. Toggle the Zero calibration bit (0th bit of n+1 CH) from “0” to “1”.

4. F159 starts Zero calibration procedures when it acknowledges an ON edge (0 → 1) of the Zero calibration bit.

5. Zero calibration in progress bit (4th bit of n+6 CH) turns on “1”. Do not touch the sensing portion (load cell) while this bit in on.

6. Make sure weight reading shows “00000”.

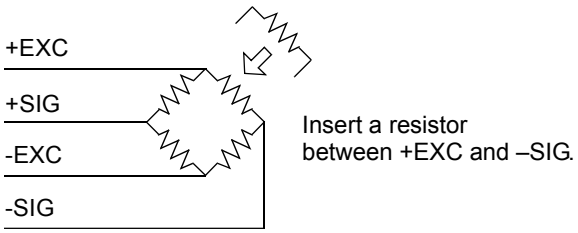
7. Toggle the Zero calibration bit (0th bit of n+1 CH) back to “0”.

If any of calibration errors occur, the user must take appropriate measures to correct the error, and retry Zero calibration.
For further information about the error codes, see Section 9-1. "Error Code and Error Assistance Code" , page97.

Calibration Error 2

Initial dead load exceeds the zero adjustable range of the F159. Check if the cell is loaded with any extra object.

If the **Calibration Error 2** persists while the system is loaded correctly, Zero calibration must be performed again after inserting a resistor between +EXC and –SIG terminals of the load cell for shifting zero point. The relation between input signal shift and resistor values are summarized in the table below.



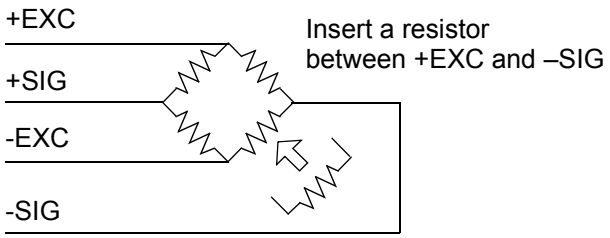
Resistor		Voltage shift equivalent strain	
Calculated	Approximate value	μ-STRAIN	mV/V
875 KΩ	866 KΩ	200	0.1
437 KΩ	442 KΩ	400	0.2
291 KΩ	294 KΩ	600	0.3
219 KΩ	221 KΩ	800	0.4
175 KΩ	174 KΩ	1000	0.5
146 KΩ	147 KΩ	1200	0.6
125 KΩ	124 KΩ	1400	0.7
109 KΩ	110 KΩ	1600	0.8
97 KΩ	97.6 KΩ	1800	0.9
87.3 KΩ	86.6 KΩ	2000	1.0
79.4 KΩ	78.7 KΩ	2200	1.1
72.7 KΩ	73.2 KΩ	2400	1.2
67.1 KΩ	66.5 KΩ	2600	1.3
62.3 KΩ	61.9 KΩ	2800	1.4
58.2 KΩ	57.6 KΩ	3000	1.5
54.5 KΩ	54.9 KΩ	3200	1.6
51.3 KΩ	51.1 KΩ	3400	1.7
48.4 KΩ	48.7 KΩ	3600	1.8
45.9 KΩ	46.4 KΩ	3800	1.9
43.6 KΩ	43.2 KΩ	4000	2.0
41.5 KΩ	41.2 KΩ	4200	2.1
39.6 KΩ	39.2 KΩ	4400	2.2
37.9 KΩ	38.3 KΩ	4600	2.3
36.3 KΩ	36.5 KΩ	4800	2.4
34.8 KΩ	34.8 KΩ	5000	2.5

- The values contained in the table assume single 350Ω load cell configuration.
- Temperature coefficient of the resistor directly affect reading accuracy. Use resistor with temperature coefficient better than 50ppm/ ℃ (5ppm/ ℃ class recommended)

Calibration Error 3

Initial dead load overshoots to negative range. Check if the cell is loaded in opposite direction, or +SIG and –SIG of the load cell are connected in reverse order.

If Calibration Error 3 persists while load direction and cable connections are correct, Zero calibration must be performed again after inserting a resistor between +EXC and –SIG terminals of the load cell for shifting zero point. See the table in the previous section “Calibration Error 2” for determining the resistor to be inserted.



4-5. Span Calibration

In this procedure, a known test load is placed on the cell to adjust the meter to indicate the desired reading.

1. Place a weight with exactly the same value as defined in Balance weight value on the load cell. (Heavier than 50% Capacity load is recommended for better linearity.)

2. Check the load cell is free from undesired extra loading: extra foreign object on the weighing plate, or contact with peripheral object.

3. Make sure that the “stable” bit (10th bit of n+5 CH) is set to “1”.
(Calibration procedures must be performed while reading is stable)

4. Toggle the Span calibration bit (1st bit of n+1 CH) from “0” to “1”.

5. F159 starts Zero calibration procedures when it acknowledges an ON edge (0 → 1) of the Span calibration bit.

6. Span calibration in progress bit (5th bit of n+6 CH) turns on “1”. Do not touch the sensing portion (load cell) while this bit in on.

7. Make sure that the reading exactly coincides with the desired value (e.g., Balance weight value).

8. Toggle the Span calibration bit (1st bit of n+1 CH) back to “0”.

If any of calibration errors occur, the user must take appropriate measures to correct the error, and retry Zero calibration.
For further information about the error codes, see Section 9-1. "Error Code and Error Assistance Code" , page97.

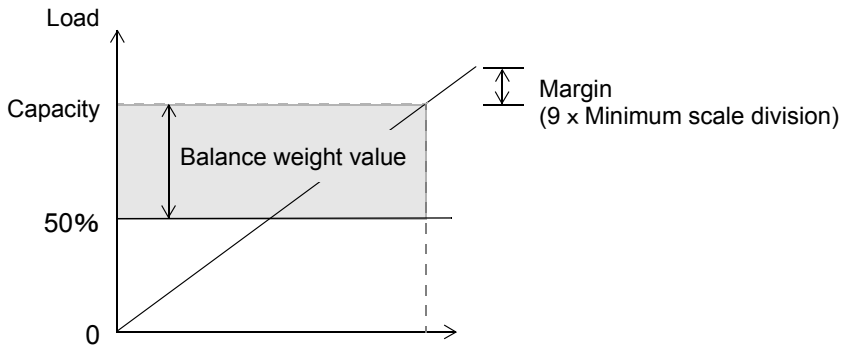
Calibration Error 1

Zero calibration must be performed again. In standard calibration procedures, Zero calibration is performed first, followed by Span calibration. However, if the result of the Span calibration is significantly off the target, F159 displays "Calibration Error 1". If this happens you must perform Zero calibration. Correctly performed Zero calibration will clear the error message.

Calibration Error 4

Value set for Balance weight and/or Span calibration is larger than Capacity setting. Modify setting for Balance weight and/or Span calibration and retry Span calibration.

Capacity and Balance weight value



For accurate Span calibration, Balance weight value should be selected between 50%-100% of Capacity.

Calibration Error 5

Balance weight value is preset to "00000". Select a proper non-zero value.

Calibration Error 6

The load cell output falls short of the F159's allowable span adjustment range. Check if the load cell is loaded properly, and if its output specification meets F159 requirements. Then, perform Span calibration again.

Calibration Error 7

Load cell output varies in negative range. Check if the cell is loaded in opposite direction, or +SIG and –SIG of the load cell are connected in reverse order. Then, perform Span calibration again.

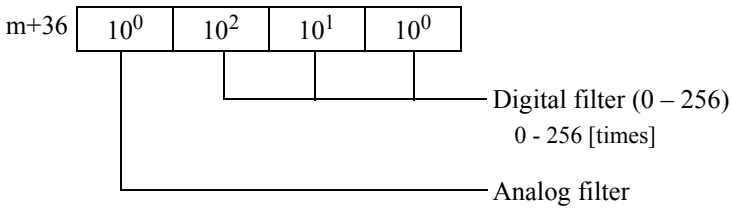
Calibration Error 8

Load cell output is outside the F159's allowable span adjustment range. Check if the load cell is properly loaded, and the its rated output falls within the F159's span adjustable range. Perform Span calibration again. Then, perform Span calibration again.

5. DISPLAY SETTINGS

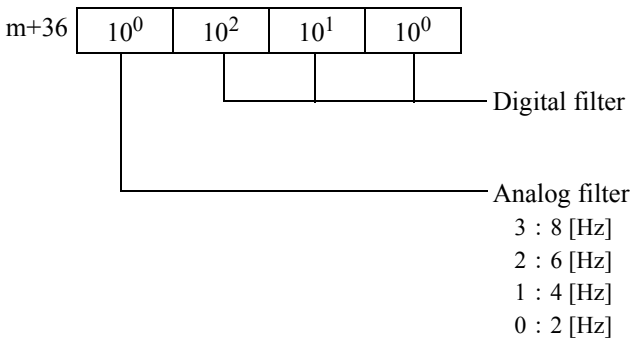
5-1. Digital Filter

This filter calculates moving average of A/D converter output to reduce reading fluctuation. Averaging width (number of data points) can be any between 0 (averaging OFF) to 256. Larger averaging width will enhance reading stability, but reduce response performance. Vice versa, shorter averaging width reduces reading stability, but enhance response velocity. Select optimal value according to the characteristics of each application.



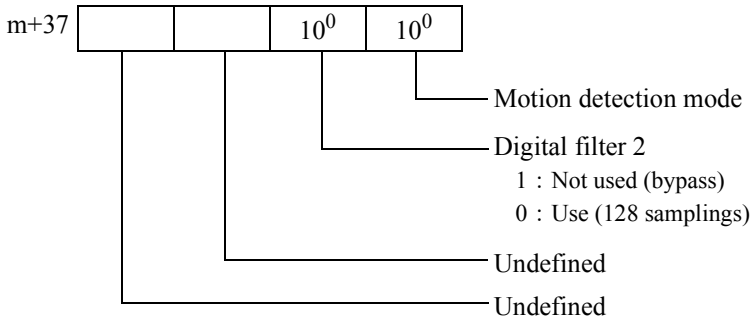
5-2. Analog Filter

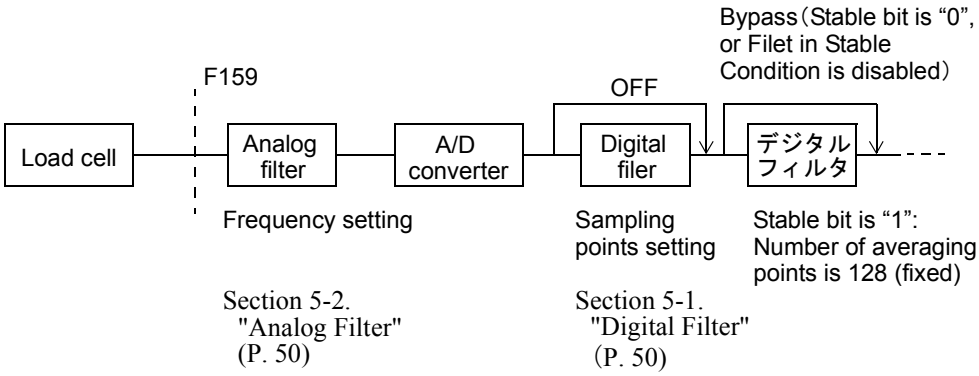
Analog low-pass filter to remove undesirable noise components from the load cell input. Cut-off frequency can be selected from 2, 4, 6, 8 Hz. Higher cut-off frequency will enhance filter response, but more noise components pass through the filter. Select optimal value according to the characteristics of each application.



5-3. Digital Filter 2

When reading becomes sufficiently stable, this function automatically inserts a digital filter to further reduce reading fluctuation. This is a user selectable optional function. For further information on stability criteria, see Section 5-4. "Motion Detection (MD)" , page52.





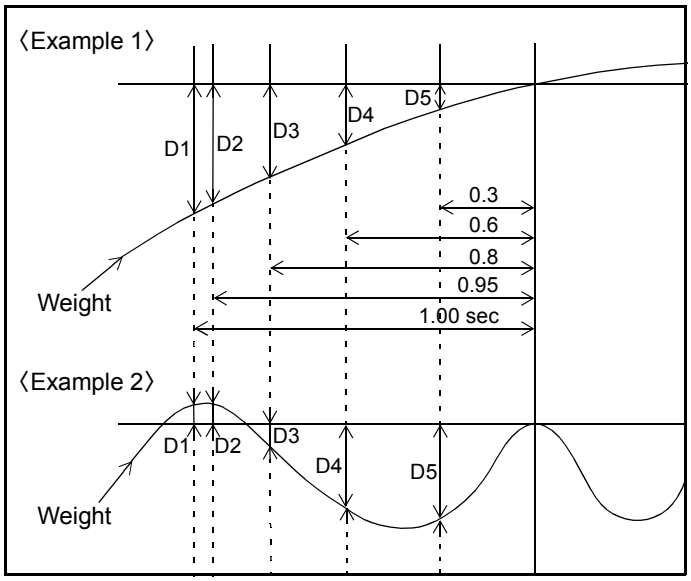
5-4. Motion Detection (MD)

MD（Motion detection）evaluates stability of weight reading and set a value to the criteria parameter accordingly. When weight reading remains within a specified range for a specified period of time, the system considers the reading stabilized and set Stable bit (10th bit of n+5 CH) to “1”.
Motion detection has two operation modes: Stable mode and Checker mode.

Stable mode

Each A/D conversion data is compared with five previously acquired data (D1-D5, see diagram below). If any one of the five difference values falls out of the specified range, Stable bit is immediately turns off “0”.

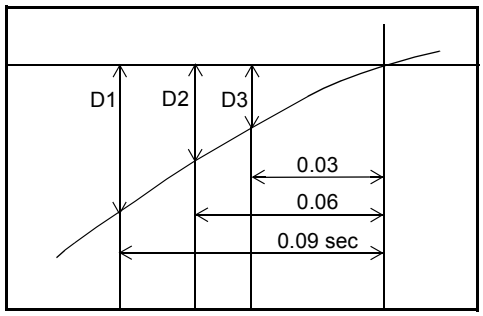
* D1 represents the weight difference between current data and the data one second before.



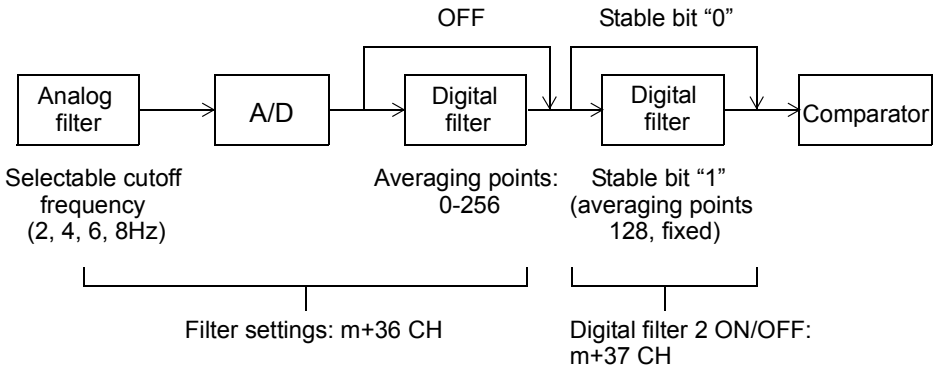
Checker mode

Each A/D conversion data is compared with three previously acquired data (D1-D3, see diagram below).
If any one of the three difference values falls out of the specified range, Stable bit is immediately turns off “0”.

* D1 represents the weight difference between current data and the data 0.09 second before.



The user can optionally insert digital filer when Stable bit becomes “1” to further reduce weight reading fluctuation.
(See Section 5-3. "Digital Filter 2" , page51.)

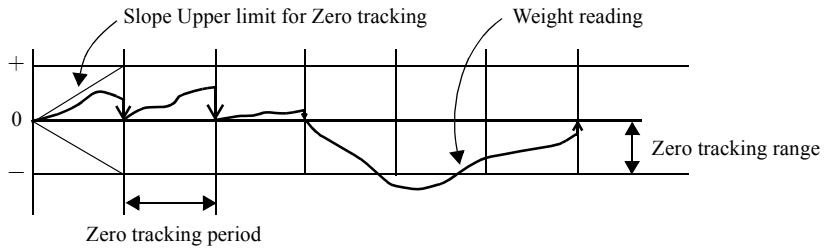


5-5. Zero Tracking (ZT)

Zero tracking automatically compensates slow system drift, as well as small zero-point shift due to residue objects on the sale such as debris, dirt and dust.

m+34			10^0	10^{-1}	Zero tracking period	0.0-9.9 sec
m+35	10^3	10^2	10^1	10^0	Zero tracking range	0-9999

- Zero tracking clear Final to zero at every specified period, if zero shift during that period remains within the specified range.
- Allowed tracking period is from 0.0 to 9.9 seconds, and Zero tracking range is from 0 to 9999 in 1/4 of scale division unit. (0002=0.5 divisions, 0012=3 divisions)
  Zero tracking is disabled if zero is specified for the period or range.



5-6. Digital Zero (DZ)

Digital Zero forces Gross weight to be zero-cleared.
Net Weight varies according to the following expression:
Net Weight = Gross weight - Tare
If Digital zero operation is performed while Gross weight exceeds DZ regulation value, Zero Error bit (13th bit of n+7 CH) is set to notify that an irregular operation has been done. In this case, DZ regulation value is subtracted from Gross weight.

* In case where Gross weight is not zero-cleared after DZ operation, or Zero Error bit is raised, check the following:

Cause	Suggested Action
Digital Zero is performed while reading is outside the DZ regulation value	・Change DZ regulation setting and try Digital Zero operation again (this is a temporary measure. Perform Zero calibration at an earliest occasion.) ・ Remove debris and dirt from the weighing vessel. ・ Check if some mechanical obstruction hinders proper measurement.

5-7. Digital Zero Clear

This function clears digital zero. Perform this function when Zero Error bit is raised (13th bit of n+7 CH) to clear digital zero and reset Zero Error bit “0”.

5-8. DZ Regulation

Set value for DZ regulation specifies a range that allows Digital Zero and Zero tracking function to compensate zero point (correction of shift from calibrated zero). If Digital Zero is performed or Zero tracking is triggered while reading exceeds the limit set by DZ regulation, Zero Error bit (13th bit of n+7 CH) is raised “1” to notify that an irregular operation has been done.

m+48	10^3	10^2	10^1	10^0	DZ regulation value: 0 - 99999
m+49				10^4	

5-9. One-Touch Tare Subtraction

This function clears Net Weight by equalizing Gross weight and Tare.
Note this function is activated only if reading is stable: stability criteria are defined in Restriction on Tare Subtraction Function.
Allowed range of Tare subtraction: All range or zero < Tare <= Capacity.

* In case where Net Weight is not zero-cleared after One-Touch Tare Subtraction, check the following:

Cause	Suggested Action
Gross weight is displayed	Net Weight is displayed in n+4, n+5 CH. Gross weight is displayed in n+2, n+3 CH Make sure you are checking correct area.
Reading is not stable (check stability criteria)	Make sure reading is stable: "1" on the 10th bit of n+5 CH indicates that reading satisfies stability criteria. Check this bit before trying to clear Net weight.
Reading is outside the allowed tare subtraction range (check range setting)	Use this function while reading is within the allowable range for tare subtraction.

5-10. One-Touch Tare Subtraction Reset

Tare subtraction can be reset by the user. Resetting tare subtraction zero-clears the set value for Tare, equalizing Net Weight and Gross weight.

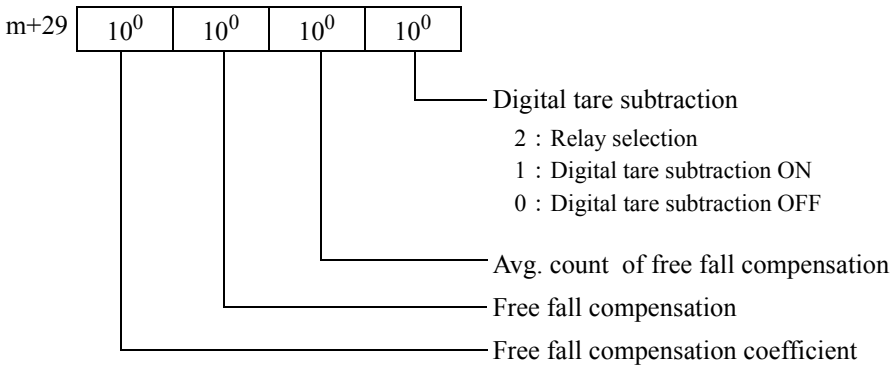
* If Net weight and Gross weight are not equalized by resetting tare subtraction, check the following.

Cause	Suggested Action
Digital tare subtraction is enabled	Zero-clear the set value for Tare, or disable Digital tare subtraction.

5-11. Digital Tare Subtraction

This function enables you to subtract arbitrary value (as tare) from Net weight. Set a value for tare (m+15, m+16 CH) and set the Digital tare subtraction bit to "1" to perform Digital tare subtraction.

m+15	10^3	10^2	10^1	10^0	Preset tare value: 0-99999
m+16				10^4	



5-12. Restriction on Tare Subtraction

The user can apply some restrictions on the action of Digital tare subtraction and One-Touch Tare Subtraction.

Tare value read

Specifies condition for reading in tare value.

Always: F159 can read in tare value anytime.

Stable: F159 read in tare value only when stable bit (10th bit of n+5 CH) is raised "1".

Range of Tare Subtraction

Specifies allowable tare range for subtraction.

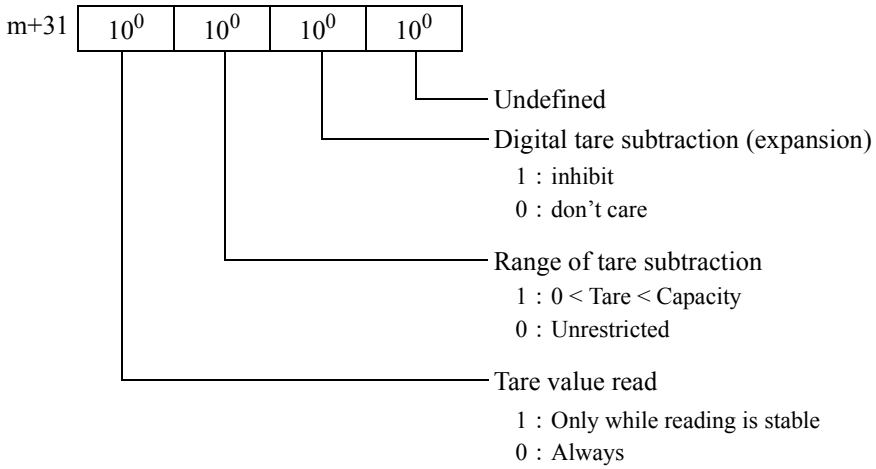
Whole range: any value is acceptable as tare

0<tare<=Capacity: a value within this range is acceptable

Digital tare subtraction (expansion)

Using this function, the user can inhibit two tare subtraction related actions while tare subtraction is enabled: modification of tare set value and ON/OFF toggling of Digital tare subtraction.

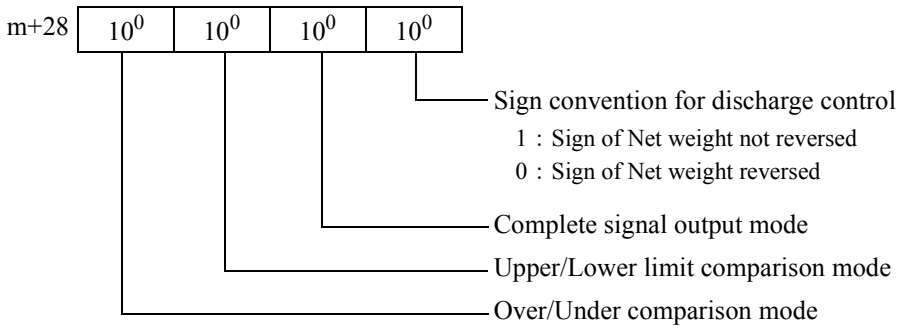
Select “1” in the relevant bit in the following register to inhibit these two actions while tare subtraction is enabled.



5-13. Sign Reversal during Discharge Control

When measuring weight of raw material tank from which a fixed quantity of material is drawn (Discharge weighing), Net weight will increase in negative direction. Using this sign reversing function, the user can obtain Net weight as a positive value.

To reverse the sign of Net weight output, select “1” in the relevant bit in the following register.



6. WEIGHING MODE SETTING AND OPERATION

Weighing mode is a method to draw specified amount of material accurately from the raw material storage (e.g. hopper, tank).

Quite an exact amount of material can be drawn from the source vessel by using a combination of such parameters and techniques including: Final, Set point 1, Set point 2, Free fall compensation, Over/Go/Under criteria, timers for Comparison Inhibit, and Judge.

This control mode has variants depending the material discharging methods: Feed weighing and Discharge weighing, simple comparison and sequence control.

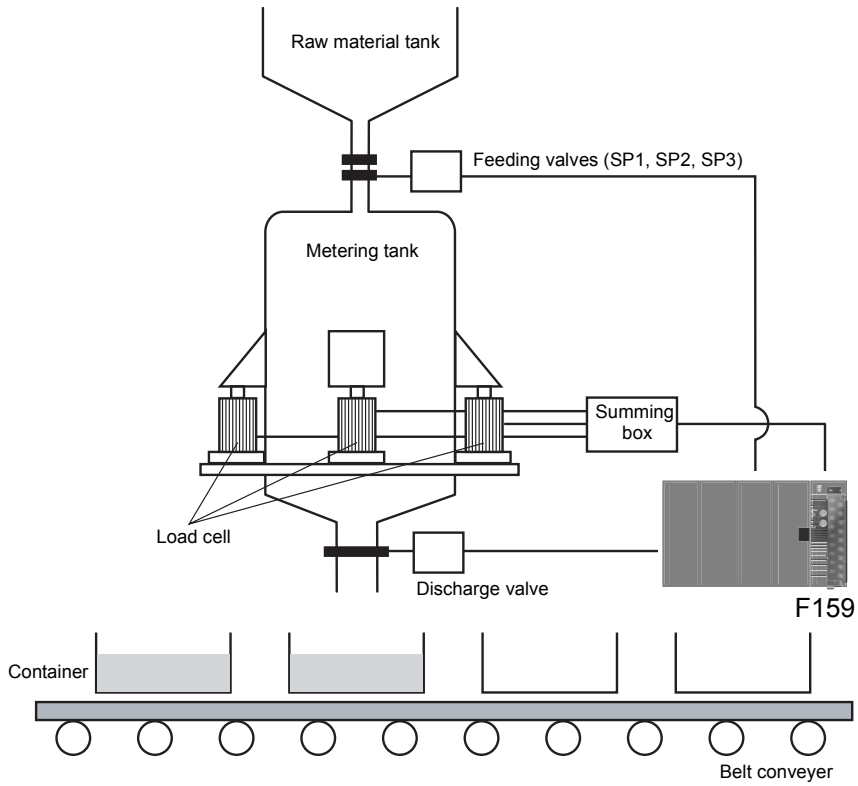
6-1. Feed Weighing and Discharge Weighing

6-1-1. Feed Weighing

This method controls weight of the metering tank (e.g. hopper) as it is being filled with raw material.

Example of Feed Weighing

In this example the metering tank is fed with raw material from the raw material tank. At first, the feeding valves are to be fully opened to feed, and closed in the order of large → medium, and medium → small at the time of Final-SP1, and Final-SP2, respectively. The feeding valves are to be completely closed at the time of Final-FF CPS.. The weighed raw materials are to be discharged to a container by opening the Discharge valves.



(1) ON edge (0 → 1) of Tare subtraction bit (0th bit of n CH) triggers tare subtraction, zero-clearing Net weight.

(2) Feeding starts with all valves full open. When the weight reaches (Final-SP1), SP1 signal turns ON (9th bit of n+3 CH) and the Comparison inhibit time starts (if enabled). Travel of the raw material tank valve changes from "large" to "medium".

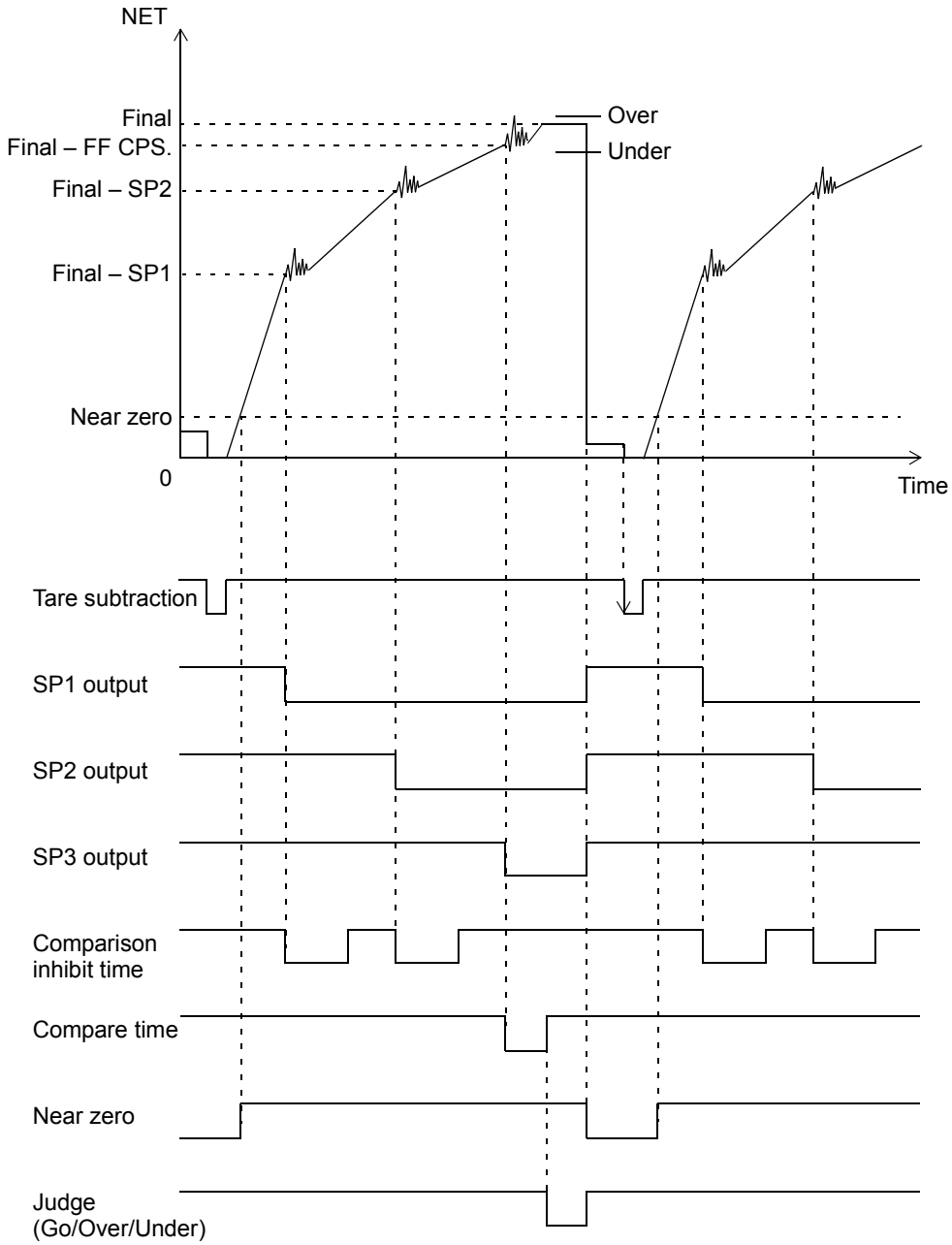
(3) When the weight reaches (Final – SP2), SP2 signal turns ON (10th bit of n+3 CH) and the Comparison inhibit time starts (if enabled). Travel of the raw material tank valve changes from "medium" to "small".

(4) When the weight reaches (Final – FF CPS.), SP3 signal turns ON (11th bit of n+3 CH) and the Compare time starts (if enabled). Feed valve is totally closed.

(5) When the Compare time expires, Over/Under judgment is made. If the weight exceeds the range of Over/Under set values, Over or Under signal is raised.

(6) Open the metering tank valve to discharge the material into the container. Completion of discharge can be confirmed by checking Near zero signal (8th bit of n+3 CH). Repeat steps (1) to (5) for the next container.

Use CJ1 or appropriate relay sequencers to open/close the Feed/ Discharge valves, and these sequencers are controlled by F159.

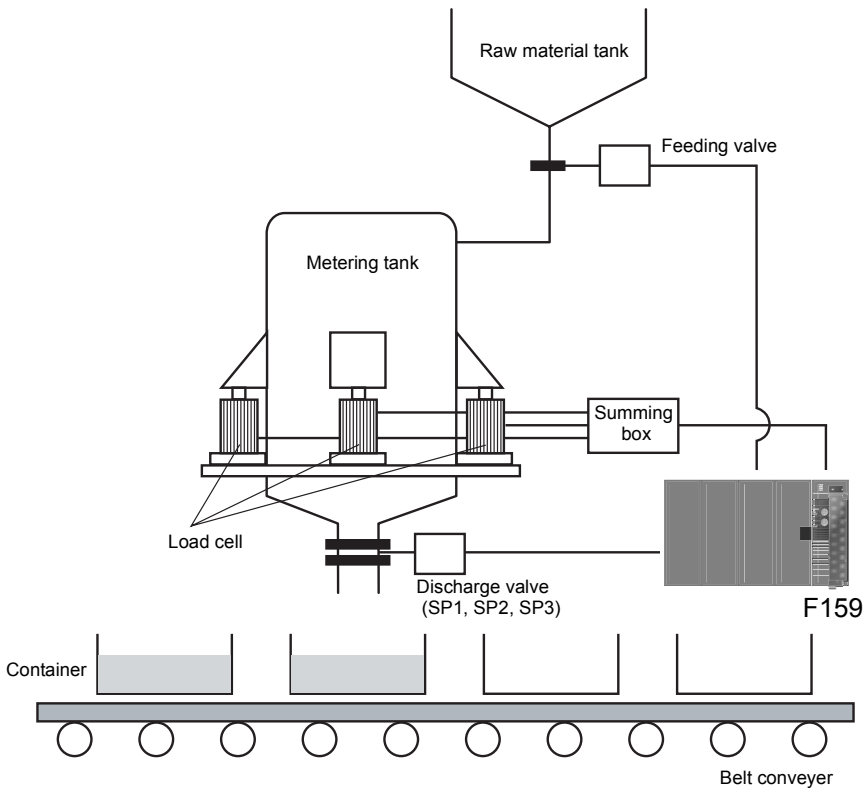

NET
Final
Final – FF CPS.
Final – SP2
Final – SP1
Near zero
0
Over
Under
Time
Tare subtraction
SP1 output
SP2 output
SP3 output
Comparison inhibit time
Compare time
Near zero
Judge (Go/Over/Under)

6-1-2. Discharge Weighing

This method controls weight of the metering tank (e.g. hopper) as it discharges material to the container. The metering tank is fed with the material from the raw material storage before discharging process begins.

Example of discharge weighing

In Discharge weighing, the amount of discharge can be weighed by adding negative weighed values. In this example system, raw materials are to be fed from the raw material tank to the metering tank, and a fixed quantity of raw materials are to be discharged from the metering tank to a container. At first, the Discharge valves of the weighing tank are to be fully opened to discharge raw materials, and the Discharge valves are to be closed in the order of large → medium, and medium → small at the time of Final-Set point 1, and Final –Set point 2, respectively. The Discharge valves are to be completely closed at the time of Final-FF CPS., when one measurement is completed. When the weighing tank runs short, the feeding valves are to be opened to replenish the metering tank with raw materials from the raw material tank to weigh.



(1) Toggling of Lower limit signal (8th bit of n+5 CH) opens the raw material tank, starting to feed the metering tank.

(2) When the metering tank is fully packed with raw material, Upper limit signal (9th bit of n+5 CH) changes and the valve closes.

(3) ON edge (0 → 1) initiates tare subtraction (0th bit of n CH) zero-clearing Net weight.

(4) Discharge starts with all valves full open. When the weight reaches (Final-SP1), SP1 signal turns ON (9th bit of n+3 CH) and the Comparison inhibit time starts (if enabled). Travel of the raw material tank valve changes from "large" to "medium".

(5) When the weight reaches (Final – SP2), SP2 signal turns ON (10th bit of n+3 CH) and the Comparison inhibit time starts (if enabled). Travel of the raw material tank valve changes from "medium" to "small".

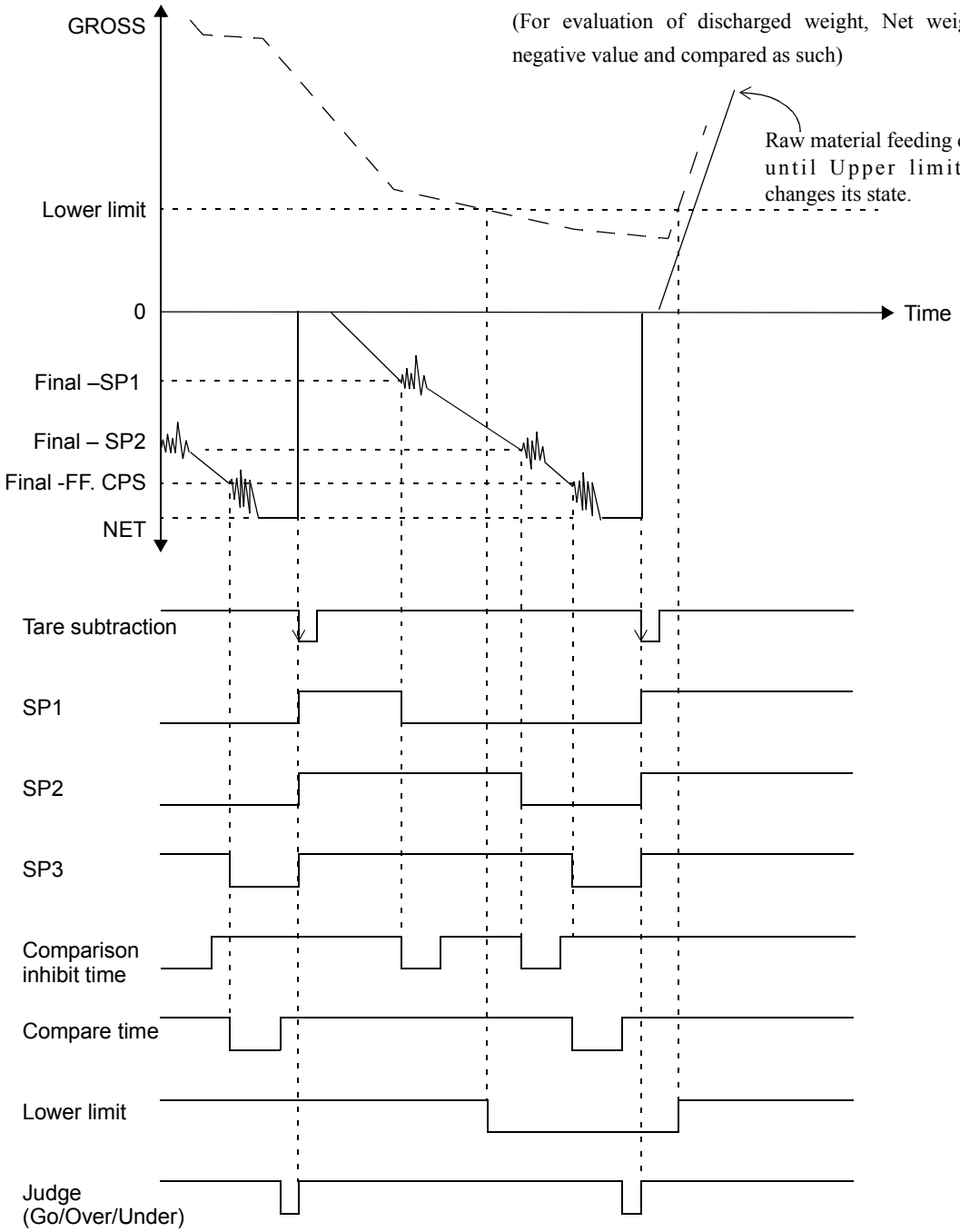
(6) When the weight reaches (Final – FF CPS.), SP3 signal turns ON (11th bit of n+3 CH) and the Compare time starts (if enabled). Feed valve is totally closed.

(7) When the Compare time expires, Over/Under judgment is made. If the weight exceeds the range of Over/Under set values, Over (15th bit of n+3 Ch) or Under (13th bit of n+3 CH) signal is raised.
Repeat steps (1) to (5) for the next container.

(8) When raw material in the metering tank decreases to the Lower limit, Lower limit signal (8th bit of n+5 CH) turns ON, opening the raw material tank valve to replenish metering tank.

Use CJ1 or appropriate relay sequencers to open/close the Feed/ Discharge valves, and these sequencers are controlled by F159.

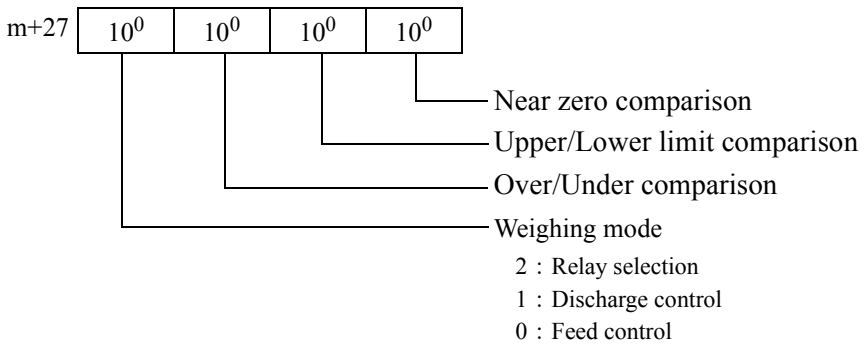
Gross weight is used for Upper/Lower limit comparison.
Net weight is used for Final, SP2, and Near zero comparison.
(For evaluation of discharged weight, Net weight takes negative value and compared as such)



Near zero signal is used to detect completion of discharge, as in the case of Feed weighing.

6-1-3. Weighing Mode

This register defines settings for Feed/Discharge control. You can select one of three options (Feed, Discharge, or Relay selection).



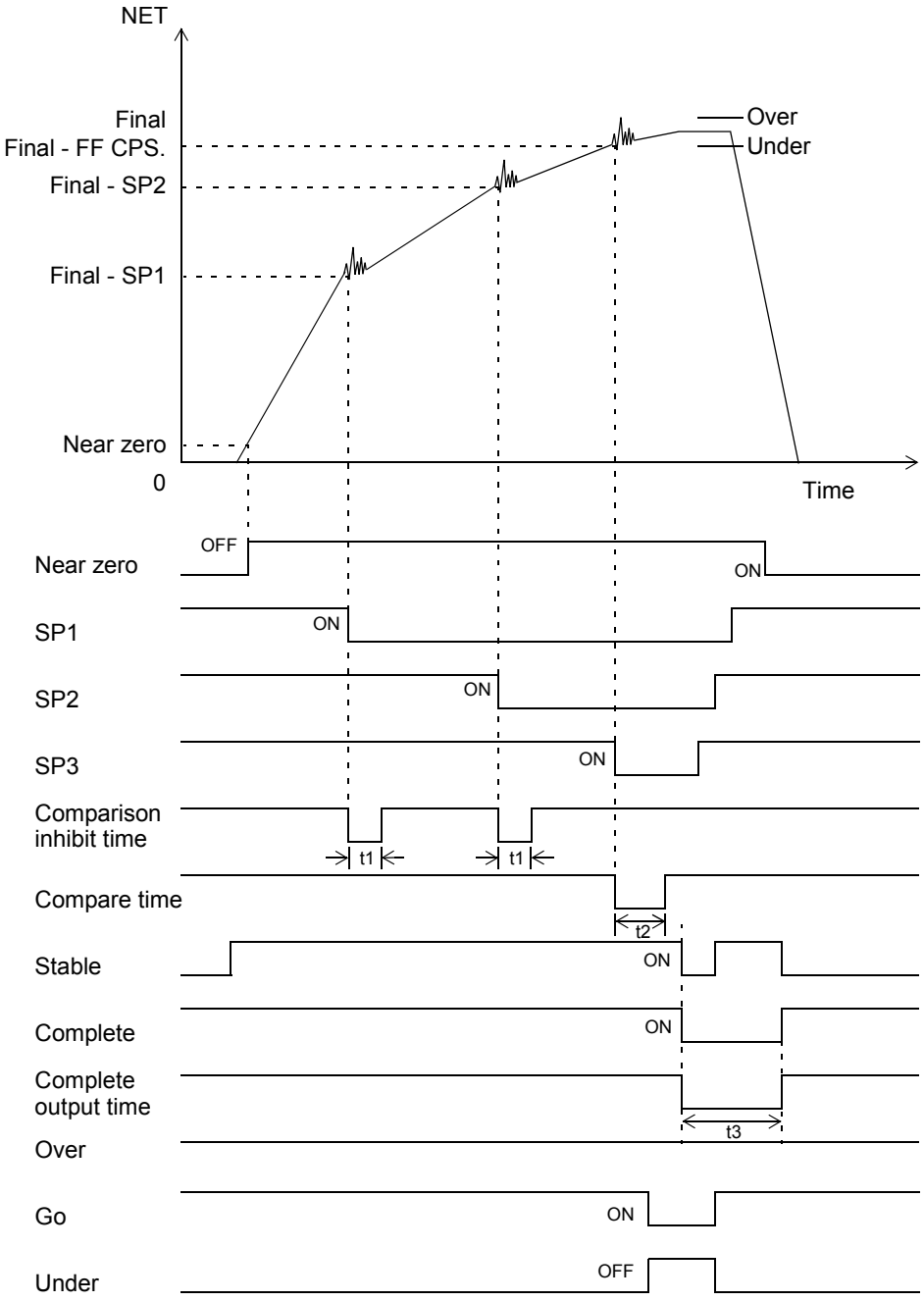
If you choose “2: Relay selection”, specify the type of Weighing mode by selecting Feed/Discharge bit (6th bit of n CH): “1” for Discharge control, “0” for Feed control.

6-2. Simple Comparison Control and Sequence Control

6-2-1. Simple Comparison Control

The simple comparison method compares the measured weight value with the discharge setting at a regular interval. The system outputs "1" when the preset condition is satisfied.

In this control method, the next control operation is only enabled when measured weight falls below 75% of the previous Final value.



・Triggering schedule of Over/Under comparison is determined by parameter settings for the Over/Under comparison mode (Weighing function 2 parameters for m+28CH). The figure illustrates operation with “Regularly” selected.

・“Complete" is output according to the conditions specified for the complete signal output mode (Weighing function 2 parameters for m+28CH).

・ t1: Comparison inhibit time m+20CH
t2: Compare time m+21CH
t3: Complete output time m+22CH

・Conditional expressions:
  ・Near zero outputs "1" when Weight value <= Near zero set value
  ・SP1 outputs "1" when Weight value >= Final - SP1
  ・SP2 outputs "1" when Weight value >= Final - SP2
  ・SP3 outputs "1" when Weight value >= Final - FF. CPS
  ・Under outputs "1" when Weight value < Final -Under
  ・Over outputs "1" when Weight value > Final+Over
  ・Go outputs "1" when Final+Over >= Weight value >= Final - Under

・Near zero comparison uses either signed values (Gross weight / Net weight) or absolute values (|Gross weight| / |Net weight|) depending on the Weighing function 1 settings for m+27CH.

・ Data used for SP1/SP2/SP3 outputs and Over/Go/Under comparison can be either Gross or Net weight depending on Weighing function 1 settings for m+27CH.

6-2-2. Sequence Control

Sequence control starts comparing the measured value (weight) with the weighing parameters when the system receives a start signal. SP1, SP2, and SP3 outputs are all initialized to "1", and one of these outputs subsequently changes to "0" depending on the result of control calculation.

Sequence control can be classified into following categories:

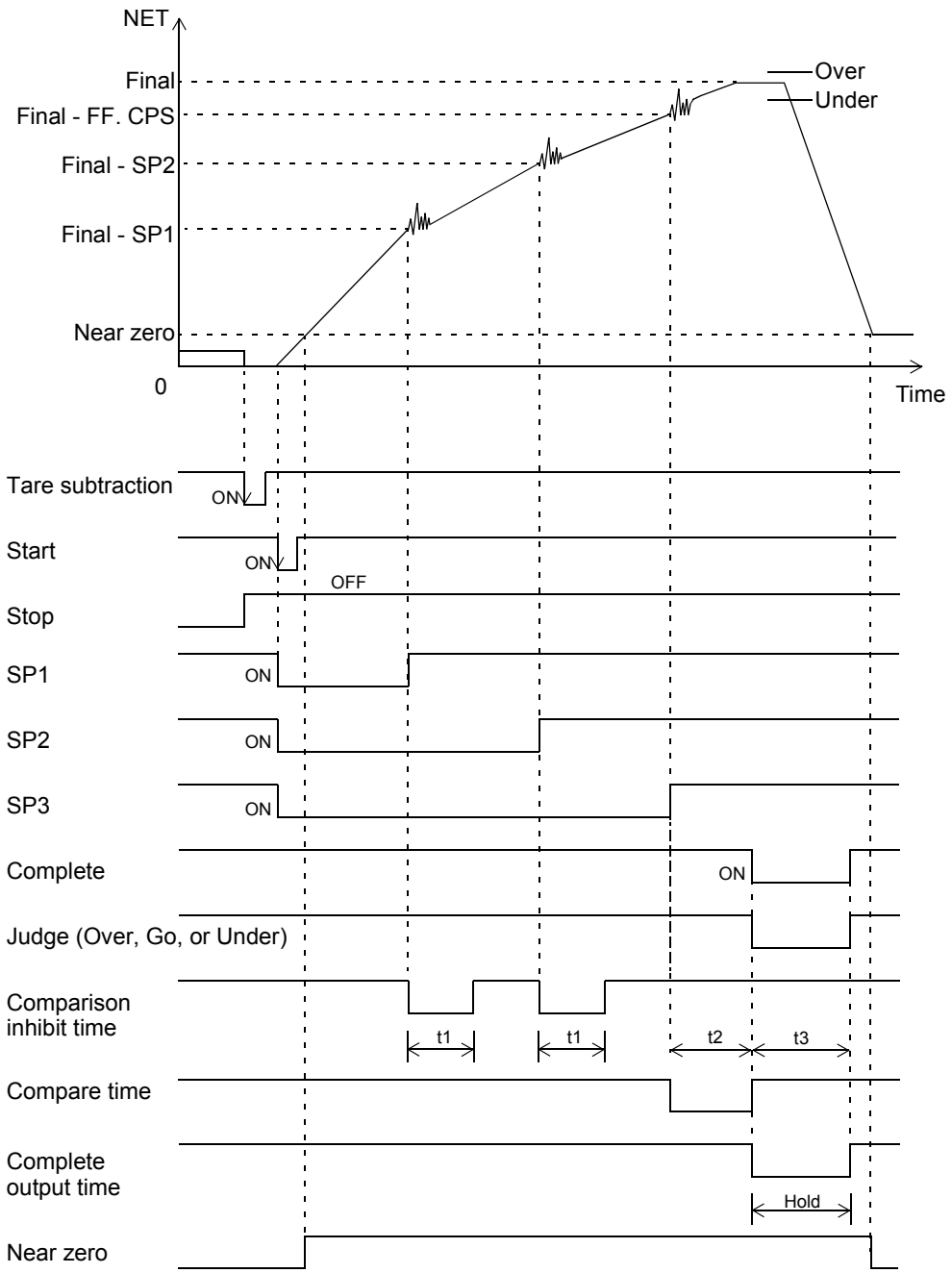
1） Normal sequence control

Control operation (weighing) starts when the system receives a start signal, and is terminated when the system sends off "Complete" signal.

2） Sequence control with Auto jog

This control mode is accompanied by Auto jog after the weighing procedures completed.

① Normal sequence control (with Over/Under comparison)



・Scheduling of "Complete" signal output is determined by parameter settings for the complete signal output mode (Weighing function 2 parameters for m+28CH).

・Over/Under comparison is performed when complete output 1 is sent out and the weight value at that moment is held. Thus, settings for Over/Under comparison mode (Weighing function 2 parameters for m+28CH) are ignored.

・ Upper/Lower limit comparison is automatically performed at a regular interval, ignoring settings for the Upper/Lower limit comparison mode (Weighing function 2 parameters for m+28CH).

・ t1: Comparison inhibit time m+20CH
t2: Compare time m+21CH
t3: Complete output time m+22CH

・Conditional expressions:
・Near zero outputs "1" when Weight value <= Near zero set value

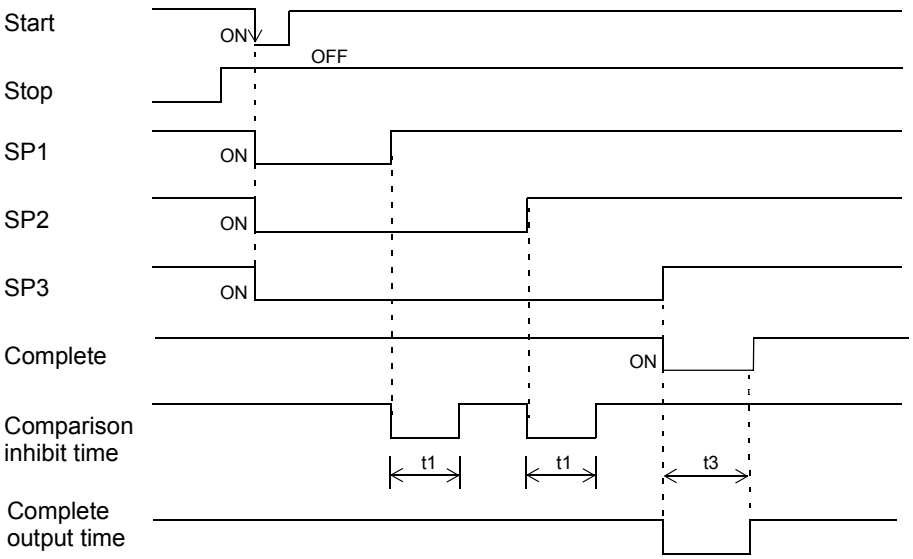
* Start signal's ON-edge (0 → 1) brings SP1, SP2, and SP3 outputs to "1".

・SP1 outputs "0" when Weight value >= Final - SP1
・SP2 outputs "0" when Weight value >= Final - SP2
・SP3 outputs "0" when Weight value >= Final - FF. CPS
・Under outputs "1" when Weight value < Final -Under
・Over outputs "1" when Weight value > Final+Over
・Go outputs "1" when Final+Over >= Weight value >= Final - Under

・Near zero comparison uses either Gross or Net weight as a reference depending on the Weighing function 1 settings for m+27CH.

・ Reference weight value used for SP1/SP2/SP3 outputs and Over/Go/Under comparison can be either Gross or Net weight depending on Weighing function 1 settings for m+27CH.

② Normal sequence control (without Over/Under comparison)

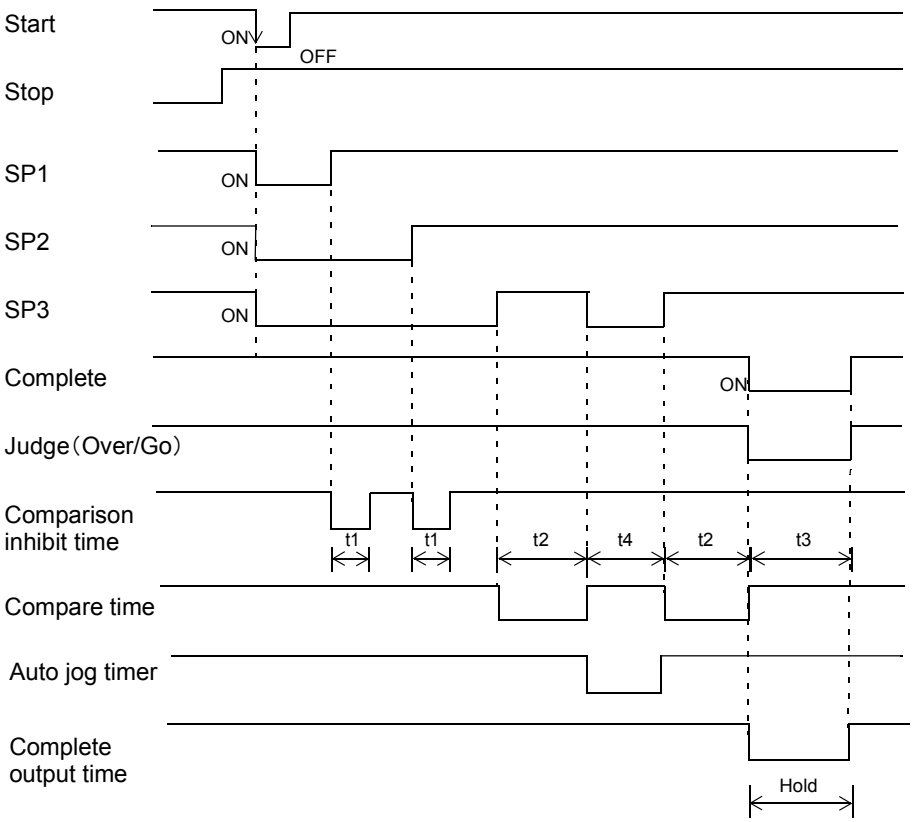


- Over/Under determination is skipped if Judging times (m+24CH) is set to "00".

- Complete signal output is triggered by the transition of Final signal (OFF-edge: 1 → 0). Note that the settings for complete signal output mode do not have effect here.

- t1: Comparison inhibit time m+20CH
  t3: Complete output time m+22CH

③ Sequence with Auto jog



・Set Auto jog (m+32CH Sequence mode) to "ON"

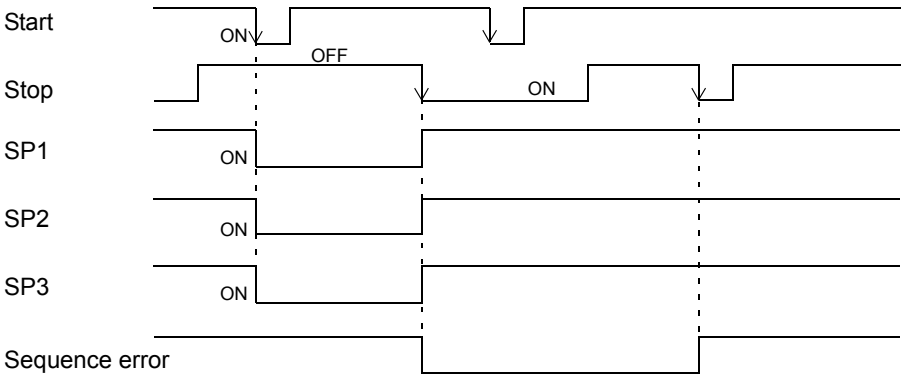
・Scheduling of Complete output is determined by the settings for complete signal output mode (Weighing function 2 for m+28CH).

・Over/Under comparison is performed when complete output 1 is sent out and the weight value at that moment is held. Thus, settings for Over/Under comparison mode (Weighing function 2 parameters for m+28CH) are ignored.

・Upper/Lower limit comparison is automatically performed at a regular interval, ignoring settings for the Upper/Lower limit comparison mode (Weighing function 2 parameters for m+28CH).

・ t1: Comparison inhibit time m+20CH
t2: Compare time m+21CH
t3: Complete output time m+22CH
t4: Auto jog timer m+23CH

Stop signal



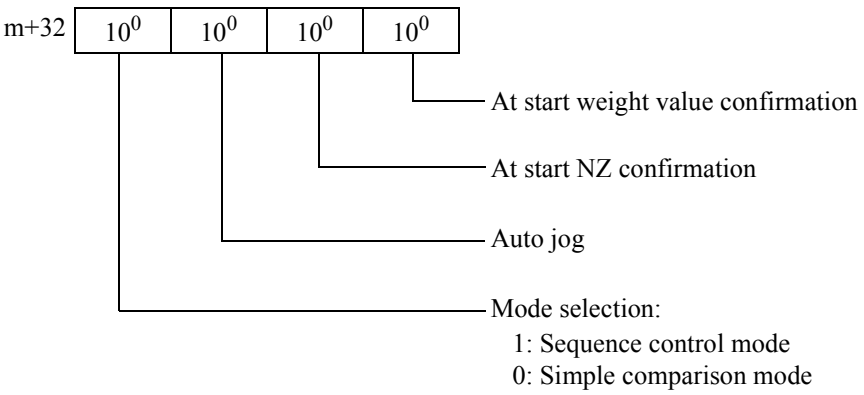
・When the stop signal turns "ON", three output signals (SP1, SP2, and SP3) are simultaneously brought to "0".

・Sequence error occurs if the start signal changes to "ON" while the stop signal is "ON".

・To recover the system from sequence error, enter stop signal again.

6-2-3. Mode Selection

This parameter is used for defining simple comparison and sequence control mode operation.



6-3. FF CPS. Regulation Value / Free Fall Compensation / Avg. Count of FF CPS. / FF CPS. Coefficient

Free fall compensation automatically correct fluctuation of free fall, which is one of the major causes of measurement error, thus enabling accurate weighing.

Principle of Free fall compensation

Sampling the weight value when the complete signal turns ON after Set point 3 finished. Record “n” times (A) the difference (D) between set Final value and actual weight value, average the difference and multiplied by compensation coefficient(C), then add/subtract the result of FF CPS. value.

Value added/subtracted to/from the FF CPS. set value

$$\frac{(D_1 + D_2 + D_3 \cdots\cdots D_A)}{A} \times C$$

To minimize error, user can set a regulation value to D. Compensation can be performed automatically as long as the following relation holds:
Final+regulation >= measured value >= Final – regulation
If Auto jog function is enabled in Sequence mode, weight is sampled befor Auto jog starts.

Request

In Free fall compensation, acquisition of compensation sample is triggered by Over/Under Judge signal. Therefore, if Judging times is set to zero, F159 can not acquire compensation samples, disabling compensation. The user must set larger than zero value to Judging times to use Free fall compensation function.
For further information, see the description in "Judging times", page 83.

Example) Final 20.000
FF CPS. regulation value 0.100
Count Of FF CPS 4
FF CPS. Coefficient 2 ／ 4

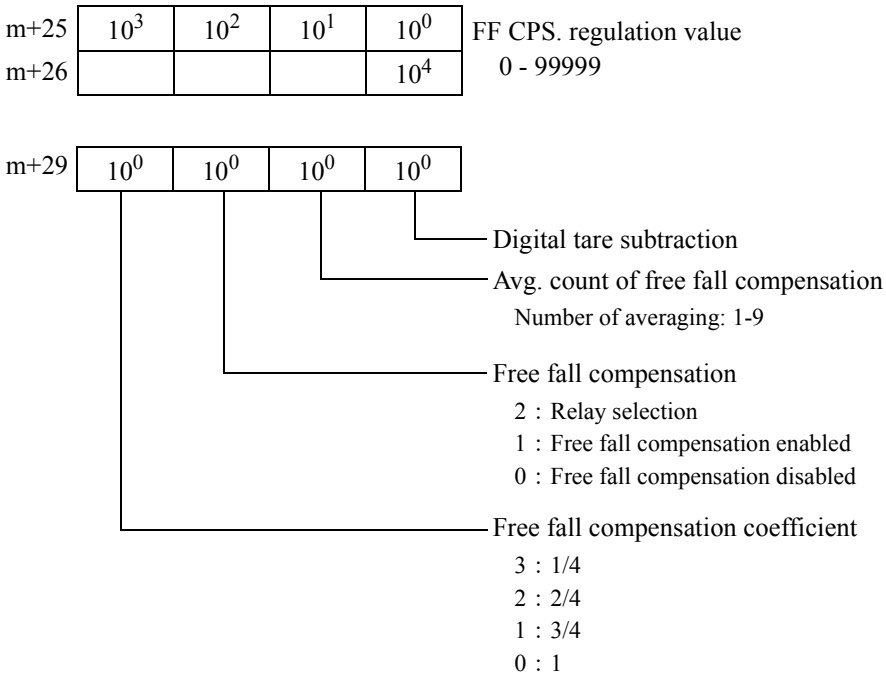
Count	Measured value	Error	FF CPS. counter	FF CPS.
0			0	← Power ON
1	20.050	+0.050	1	0.500
2	20.040	+0.040	2	0.500
3	20.070	+0.070	3	0.500
4	20.080	+0.080	4 → 0	0.500
		+0.240/4 = 0.060		
			0.060 × 2/4 = 0.030	→ Corrected value
5	20.020	+0.020	1	0.530
6	20.000	0.000	2	0.530
7	20.010	+0.010	3	0.530
8	20.110	(+0.110)	←× 3	0.530
9	20.010	+0.010	4 → 0	0.530
		+0.040/4 = 0.010		
			0.010 × 2/4 = 0.005	→ Corrected value
10	19.880	(-0.120)	←× 1	0.535
11	19.990	-0.010	1	0.535
12	20.010	+0.010	2	0.535
13	20.000	0.000	3	0.535
14	19.980	-0.020	4 → 0	0.535
		-0.020/4 = -0.005		
			-0.005 × 2/4 = -0.003	→ Corrected value
				0.532

* When set value for FF CPS. is changed, the count setting for Free fall compensation is cleared and, and its counter value is also cleared.

FF CPS. Coefficient calculation

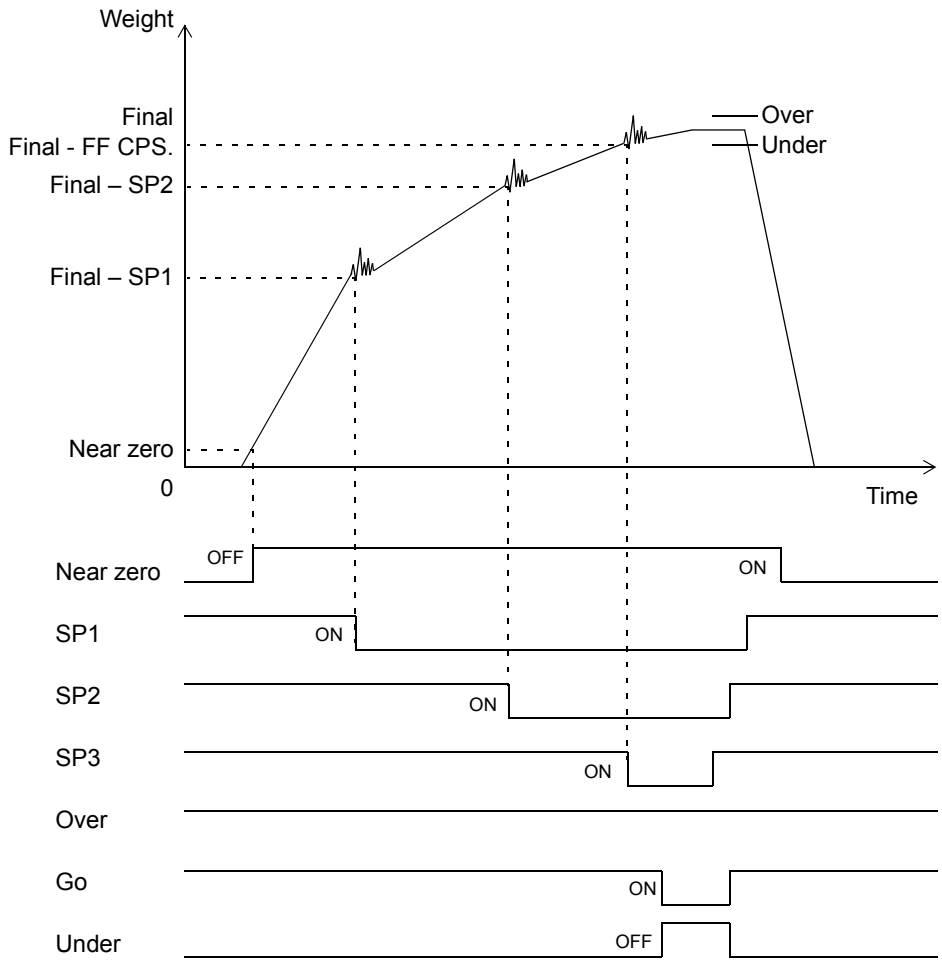
The value for the coefficient can be selected from 1/4, 2/4, 3/4 or 1.

In situation where you can expect fairly consistent measured values, the value 1 is usually sufficient. When measured values fluctuate, selection of 1/4 or 2/4 is recommended for better accuracy.


m+25
m+26
10^3
10^2
10^1
10^0
10^4
FF CPS. regulation value
0 - 99999
m+29
10^0
10^0
10^0
10^0
Digital tare subtraction
Avg. count of free fall compensation
Number of averaging: 1-9
Free fall compensation
2 : Relay selection
1 : Free fall compensation enabled
0 : Free fall compensation disabled
Free fall compensation coefficient
3 : 1/4
2 : 2/4
1 : 3/4
0 : 1

6-4. Final / Set Point 2 / Set Point 1 / FF CPS. / Over / Under

These parameters are used as target and reference values for Final discharge control.



Parameter settings for Final discharge control

Parameter	Criteria equation
Near zero	Weight <= Near zero
SP1	Weight >= Final – SP1
SP2	Weight >= Final – SP2
SP3	Weight >= Final – FF CPS.
Under	Weight < Final - Under
Over	Weight > Final + Over
Go	Final + Over >= Weight >= Final - Under

m+13	10^3	10^2	10^1	10^0	Final	00000 - 99999
m+14				10^4		

m+8	10^3	10^2	10^1	10^0	SP2	00000 - 99999
m+9				10^4		

m+6	10^3	10^2	10^1	10^0	SP1	00000 - 99999
m+7				10^4		

m+10	10^3	10^2	10^1	10^0	FF CPS.	0000 - 9999

m+11		10^2	10^1	10^0	Over	000 - 999
m+12		10^2	10^1	10^0	Under	000 - 999

* If the control does not use SP1 and SP2 signal, the values for these two parameters must be set equal to that of Final.

6-5. Near Zero / Upper Limit / Lower Limit

These parameter settings are used as reference for fixed value final discharge control.

〈Conditional equation〉

Near zero: "1" when Weight <= Near zero set value (inpur range: 0-99999)
Upper limit: "1" when Weight > Upper Limt set value (input range: 0-99999)
Lower limit: "1" when Weight < Lower limit set value (input range: 0-99999)

m+4	10^3	10^2	10^1	10^0	Near zero	00000 - 99999
m+5				10^4		

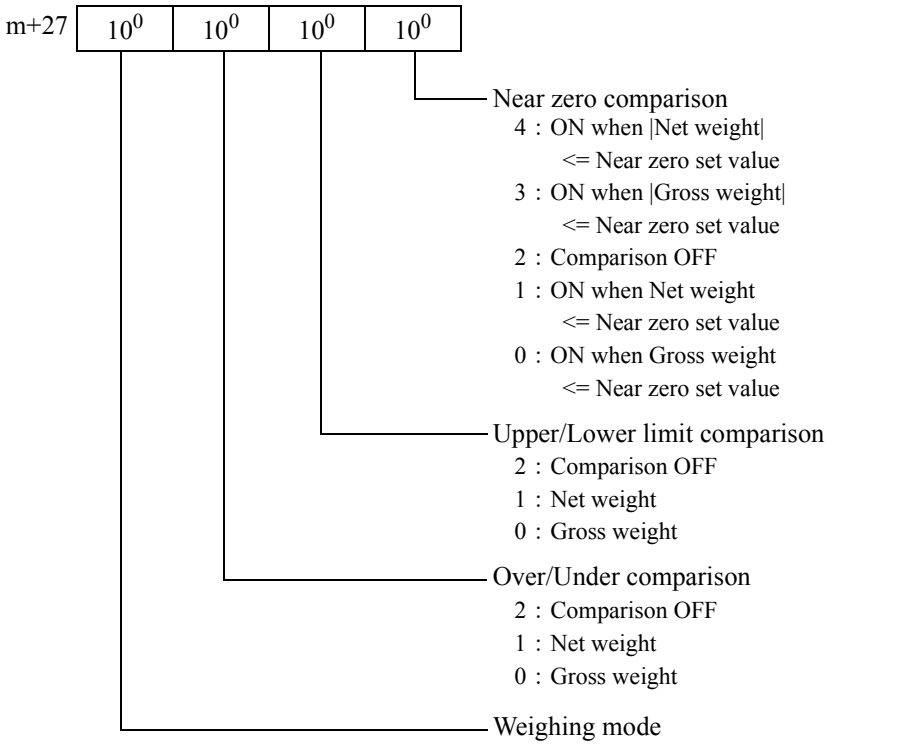
m	10^3	10^2	10^1	10^0	Upper limit 00000 - 99999
m+1				10^4	

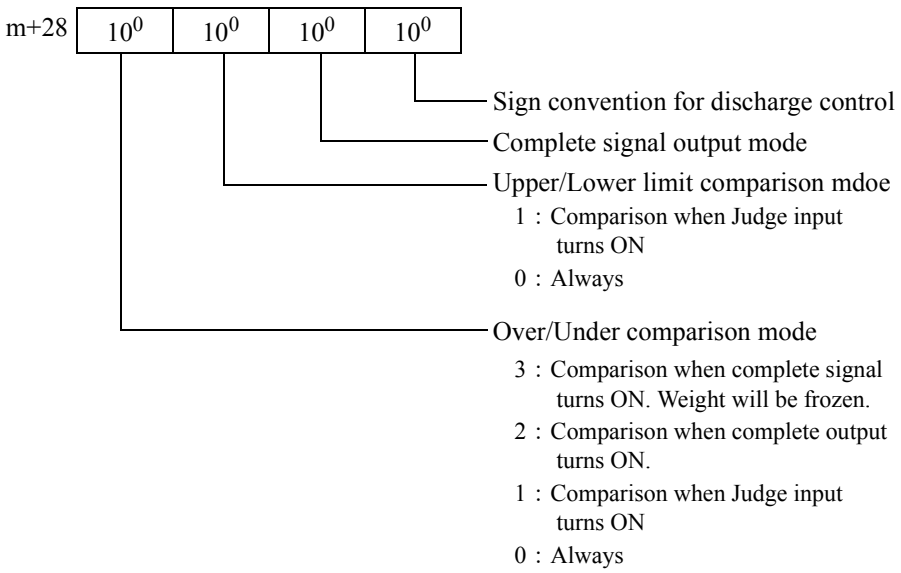
m+2	10^3	10^2	10^1	10^0	Lower limit 00000 - 99999
m+3				10^4	

6-6. U/L Limit Comparison / U/L Limit Comparison Mode/ Near zero Comparison / Over/Under Comparison / Over/Under Comparison Mode

The user uses these parameters to specify the type of weight (Net/Gross) and timing for comparing Upper/Lower, Near zero, and Over/Under.
Options for each comparison function:

U/L limit comparison:	Gross weight, Net weight or Comparison OFF
U/L limit comparison mode:	Always or Judge input ON
Near zero comparison:	Gross weight, Net weight, Comparison OFF, |Gross weight|, or |Net weight|
Over/Under comparison:	Gross weight, Net weight, Comparison OFF
Over/Under comparison mdoe:	Always, Judge input ON, Complete ON, or HOLD

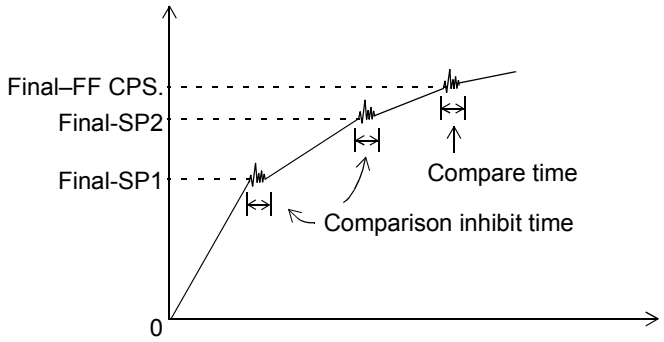

m+27
10^0 10^0 10^0 10^0
Near zero comparison
4 : ON when |Net weight| <= Near zero set value
3 : ON when |Gross weight| <= Near zero set value
2 : Comparison OFF
1 : ON when Net weight <= Near zero set value
0 : ON when Gross weight <= Near zero set value
Upper/Lower limit comparison
2 : Comparison OFF
1 : Net weight
0 : Gross weight
Over/Under comparison
2 : Comparison OFF
1 : Net weight
0 : Gross weight
Weighing mode


m+28
10^0 10^0 10^0 10^0
Sign convention for discharge control
Complete signal output mode
Upper/Lower limit comparison mdoe
1 : Comparison when Judge input turns ON
0 : Always
Over/Under comparison mode
3 : Comparison when complete signal turns ON. Weight will be frozen.
2 : Comparison when complete output turns ON.
1 : Comparison when Judge input turns ON
0 : Always

6-7. Complete Signal Output Mode / Complete Output Time / Compare Time / Comparison Inhibit Time

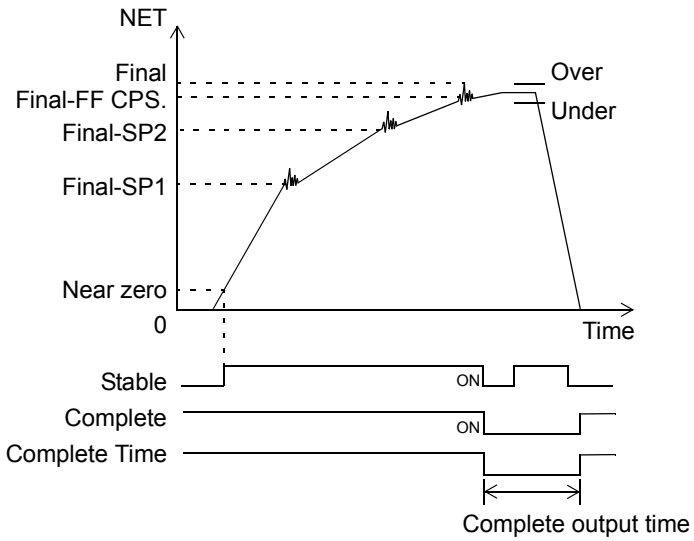
Comparison inhibit time and Compare time

Proper operation of control systems can be adversely affected by mechanical vibration induced by on/off actions of the valve. To avoid this effect, these two parameters inhibit comparison operatio for a specific period of time.

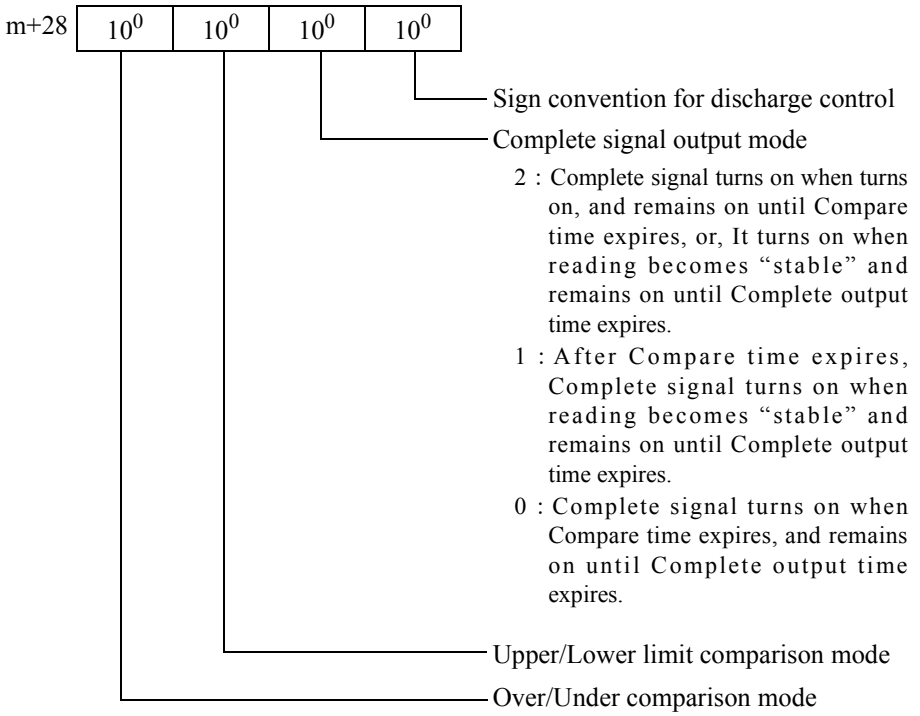


Complete Signal Output Mode and Complete output time

These two parameters define the output timing of Complete signal and its duration.



Complete signal outpu mode	Compare time/Comp.&Stable/Comp.or Stable
Complete output time	Input range: 0.00-9.99
Compare time	Input range: 0.00-9.99
Comparison inhibit time	Input range: 0.00-9.99



m+20		10^0	10^{-1}	10^{-2}	Comparison inhibit time 0.00 - 9.99
m+21		10^0	10^{-1}	10^{-2}	Compare time 0.00 - 9.99
m+22		10^0	10^{-1}	10^{-2}	Complte output time 0.00 - 9.99

6-8. Judging Times / AZ Times / At Start NZ Confirmation / At Start WV Confirmation /Auto Jog (ON/OFF) / Auto Jog Timer

Judging times

F159 can perform Over/Go/Under comparison when the measuring process is completed (synchronized with Complete signal). This two-digit number (00-99) specifies the frequency at which the comparison takes place.

00 : comparison disabled

01 : every time

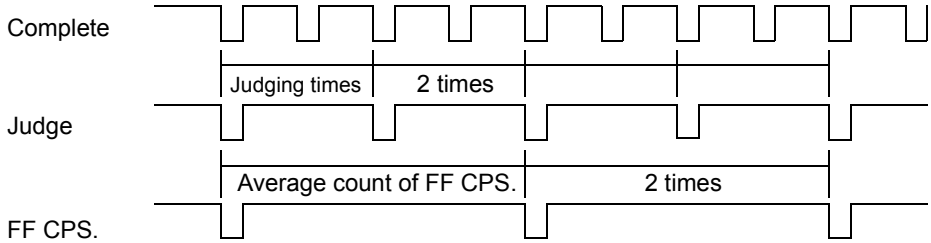
02 : once in every two outputs

03 : once in every three outputs

〈

99 : once in every 99 outputs

< Example > Judging times is set to “02”



Request

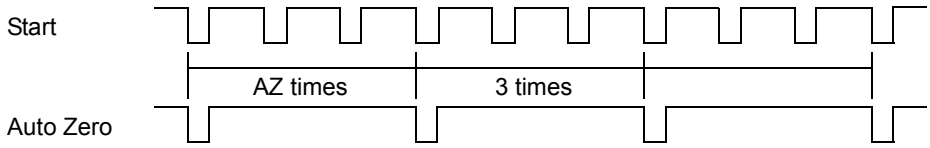
FF CPS. reads in and stores samples for compensation synchronized with Over/Under comparison signal.
Selecting “00” for Judging times inhibits F159 to collect these sample data, thus disabling Free fall compensation.
Select a non-zero value for Judging times to enable Free fall compensation.

AZ times

This two-digit (00-99) number enable/disable zero-clearance of Weight value when the metering process starts. Weight is zero-cleared using Digital Zero (if Weight is set to Gross) or Tare Subtraction (if Weight is set to Net).

00 : Auto zeroing is disabled
01 : every time
02 : once in every two weighing processes
03 : once in every three weighing processes
〈
99 : once in every 99 weighing processes

< Example > AZ times is set to “03”



・Auto Zero is executed when the Start signal turns ON.

・Auto Zero is executed when the Start signal turns ON.

・Disabling Auto Zero “00” does not inhibit Tare subtraction and Digital Zero operation.

At start NZ confirmation

You can enable/disable Near zero check at the start of weighing sequence. The weighing sequence can start if Near zero is ON, and it is inhibited to start if the bit is “0”, generating “Sequence Error 4”.

For furthre information on Near zero settings, see Section 6-5. "Near Zero / Upper Limit / Lower Limit" , page79.

At start WV confirmation

You can enable/disable the F159 to check if the weight is equal or larger than SP1 point (Final – SP1 set value).

“Sequence Error 5” is generated if the initial weight is equal or larger then SP1 point.

For furthre information on SP1 settings, see Section 6-4. "Final / Set Point 2 / Set Point 1 / FF CPS. / Over / Under" , page78.

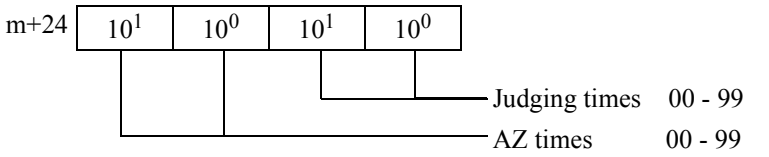
Auto jog

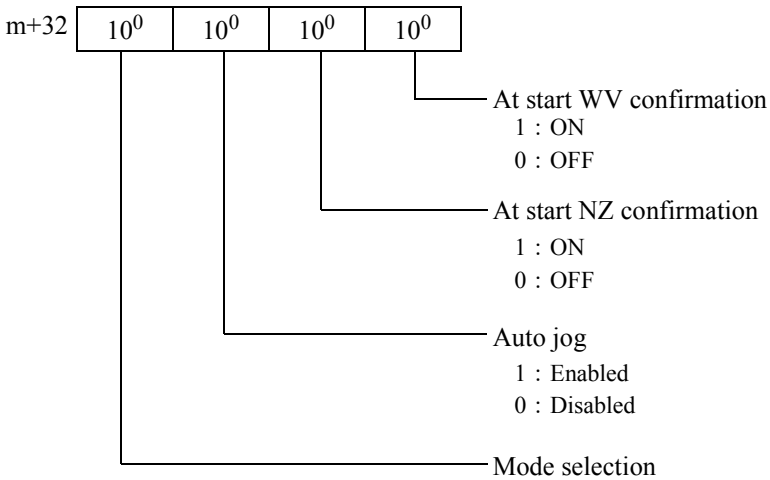
This parameter enable/disable (ON/OFF) the Auto jog function.

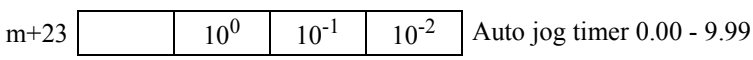
Auto jog timer

This parameter specifies the Auto jog timer (allowable range: 0.00-9.99)

Auto Jogging is allowed only in the Sequence mode.
If Over/Under check decides that the weight is stll short of the desired value (Under), SP3 will turns ON again until Auto jog timer expires.







6-9. Net Weight Over / Gross Weight Over

This function is used to generate alarm if Net weight/Gross weight exceeds the user specified limit. Allowable input and output range are as follows:

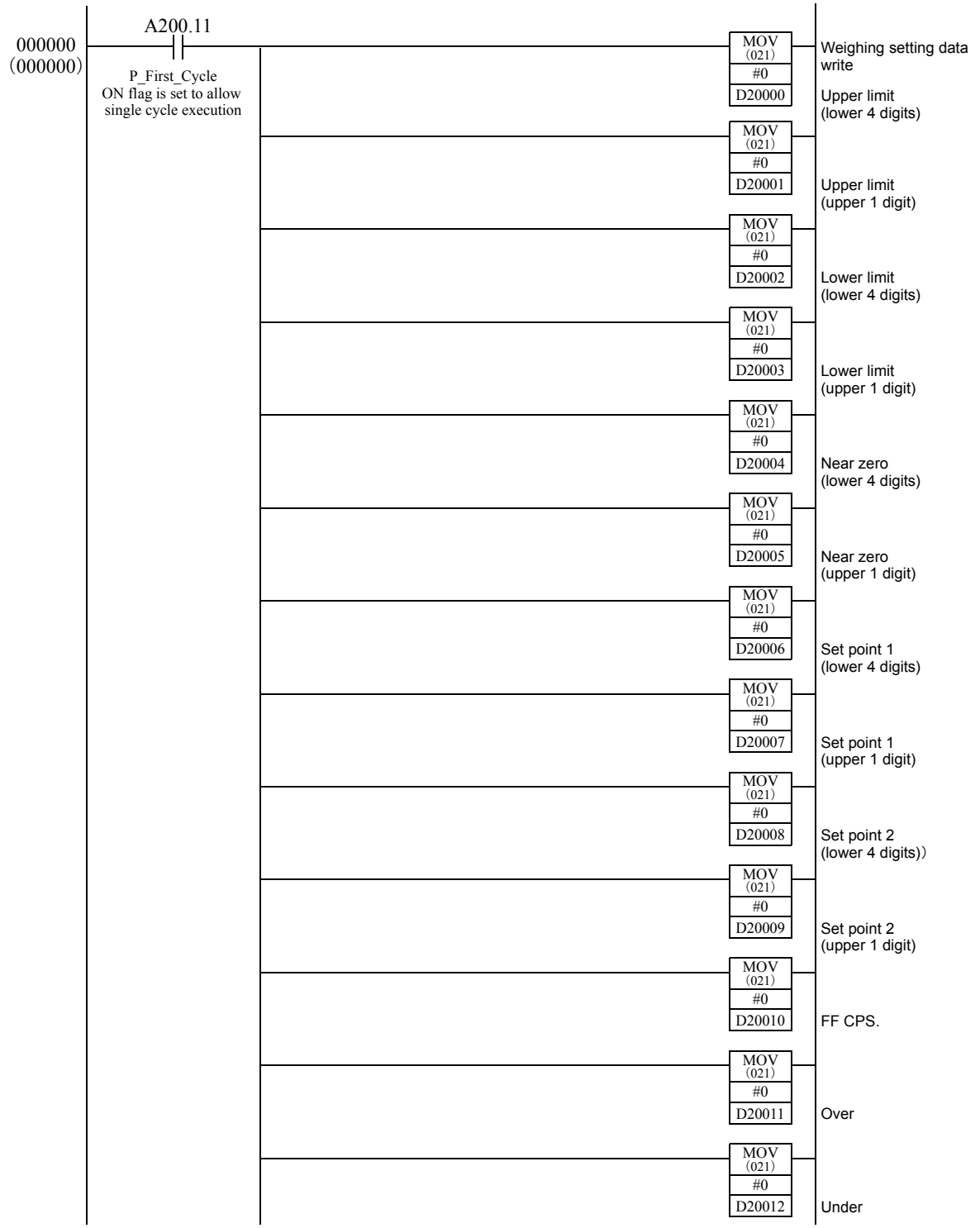
Net weight Over (input range: 0-99999)
Gross weight Over (input range: 0-99999)

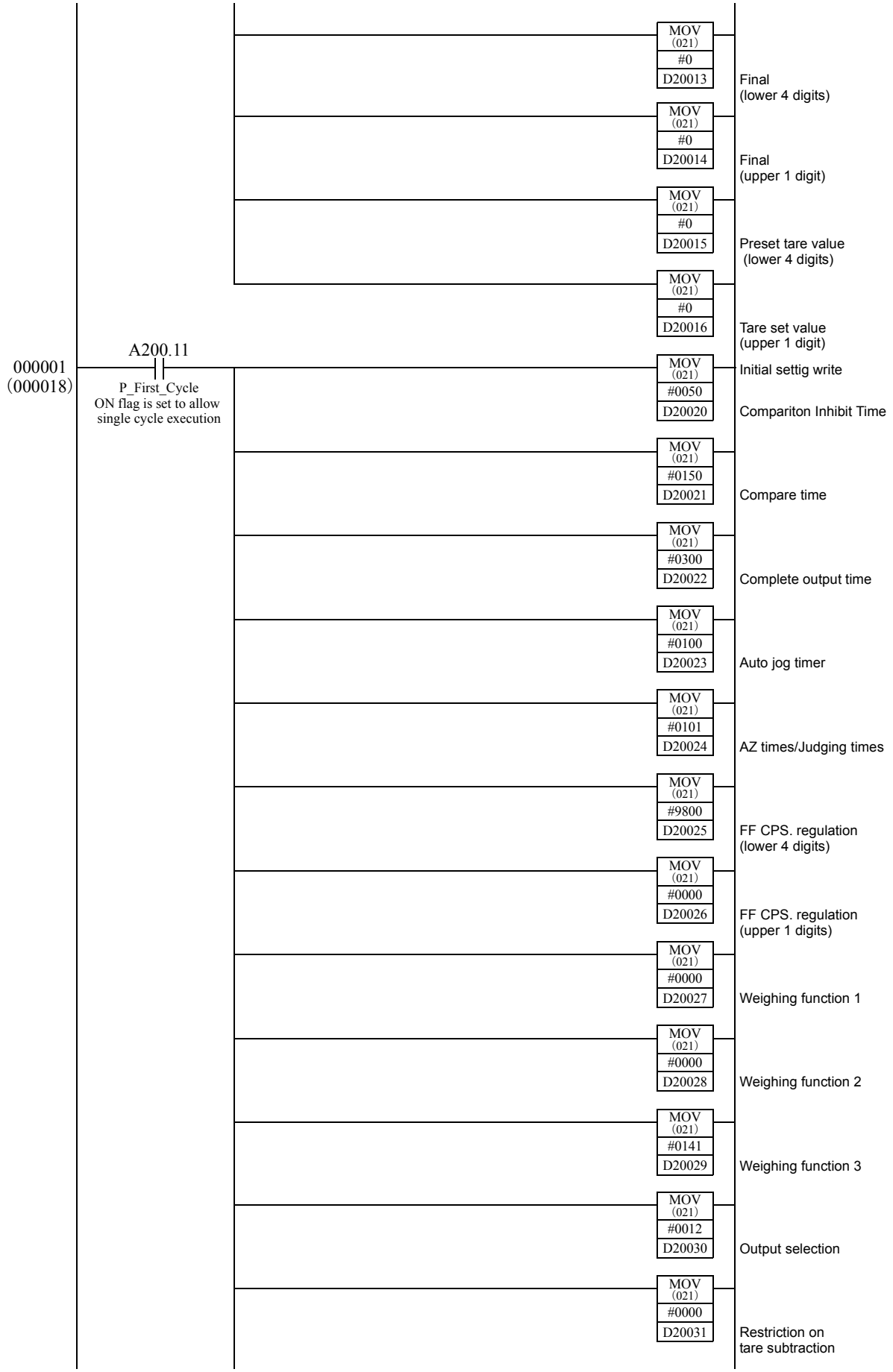
	Conditional equation	Output
Net weight Over	Net weight > Net weight Over set value	10th bit of n+7 CH
Gross weight Over	Gross weight > Gross weight Over set value	12th bit of n+7 CH

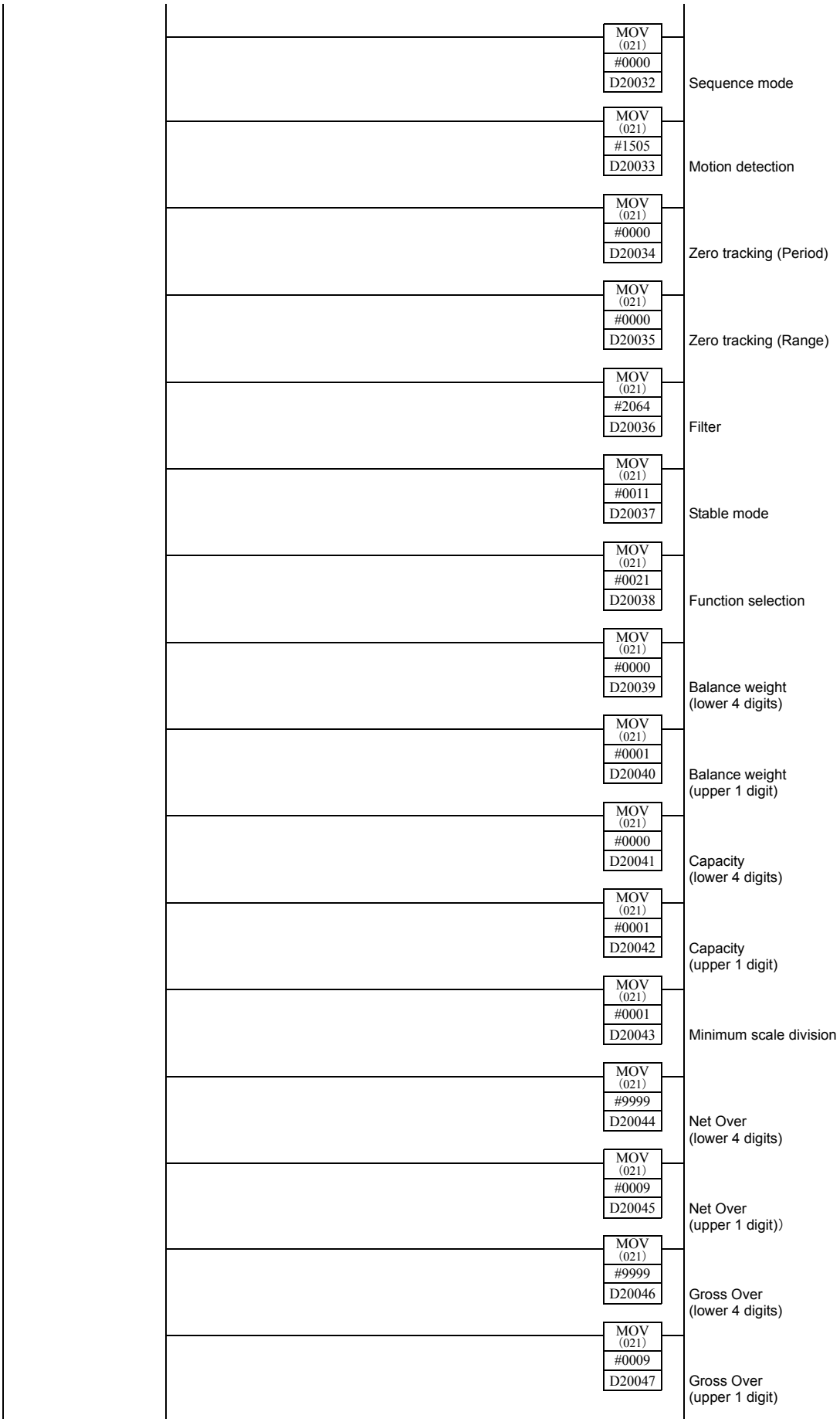
m+44	10^3	10^2	10^1	10^0	Net Over 0 - 99999
m+45				10^4	
m+46	10^3	10^2	10^1	10^0	Gross Over 0 - 99999
m+47				10^4	

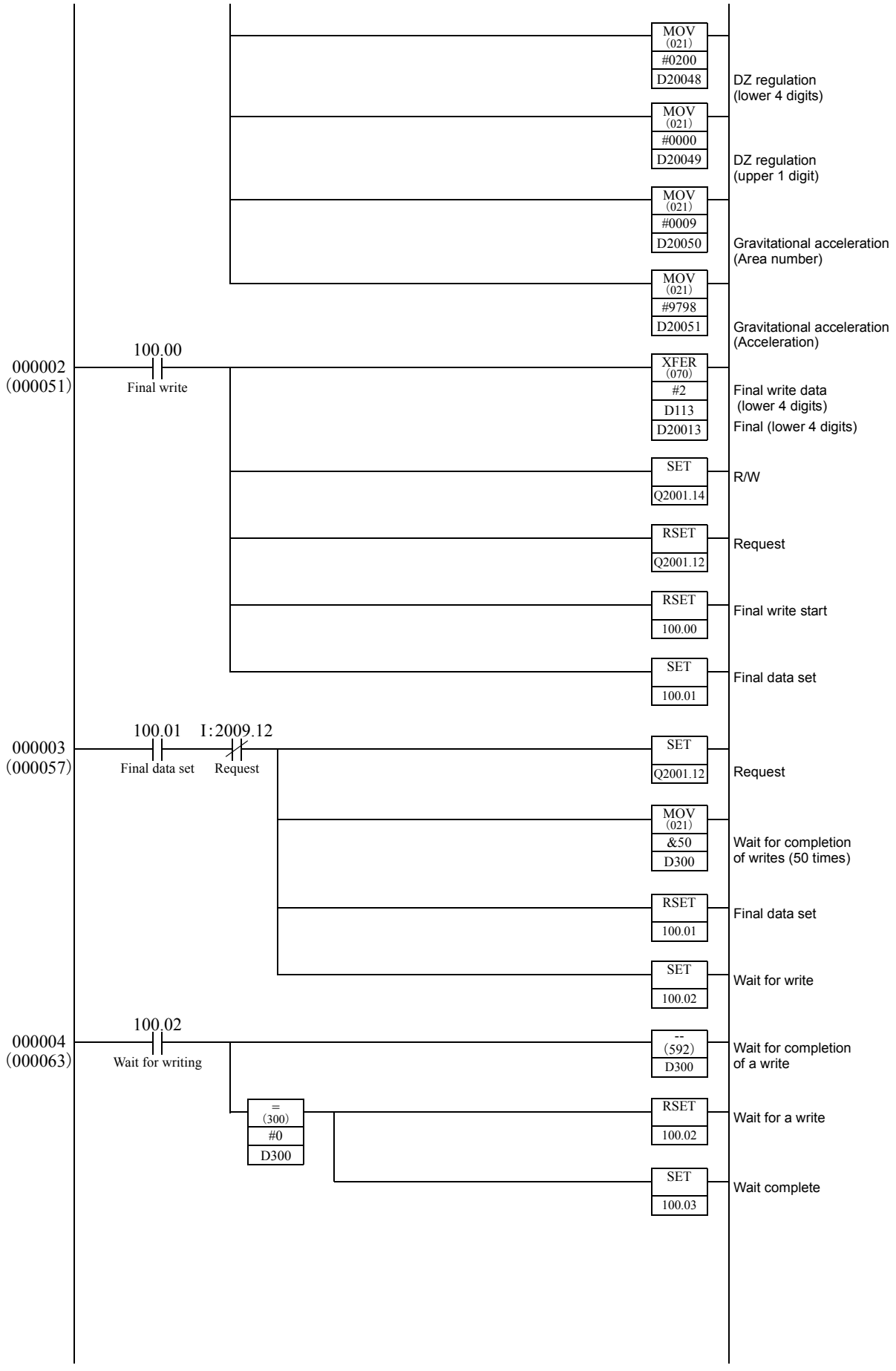
7. LADDER DIAGRAM

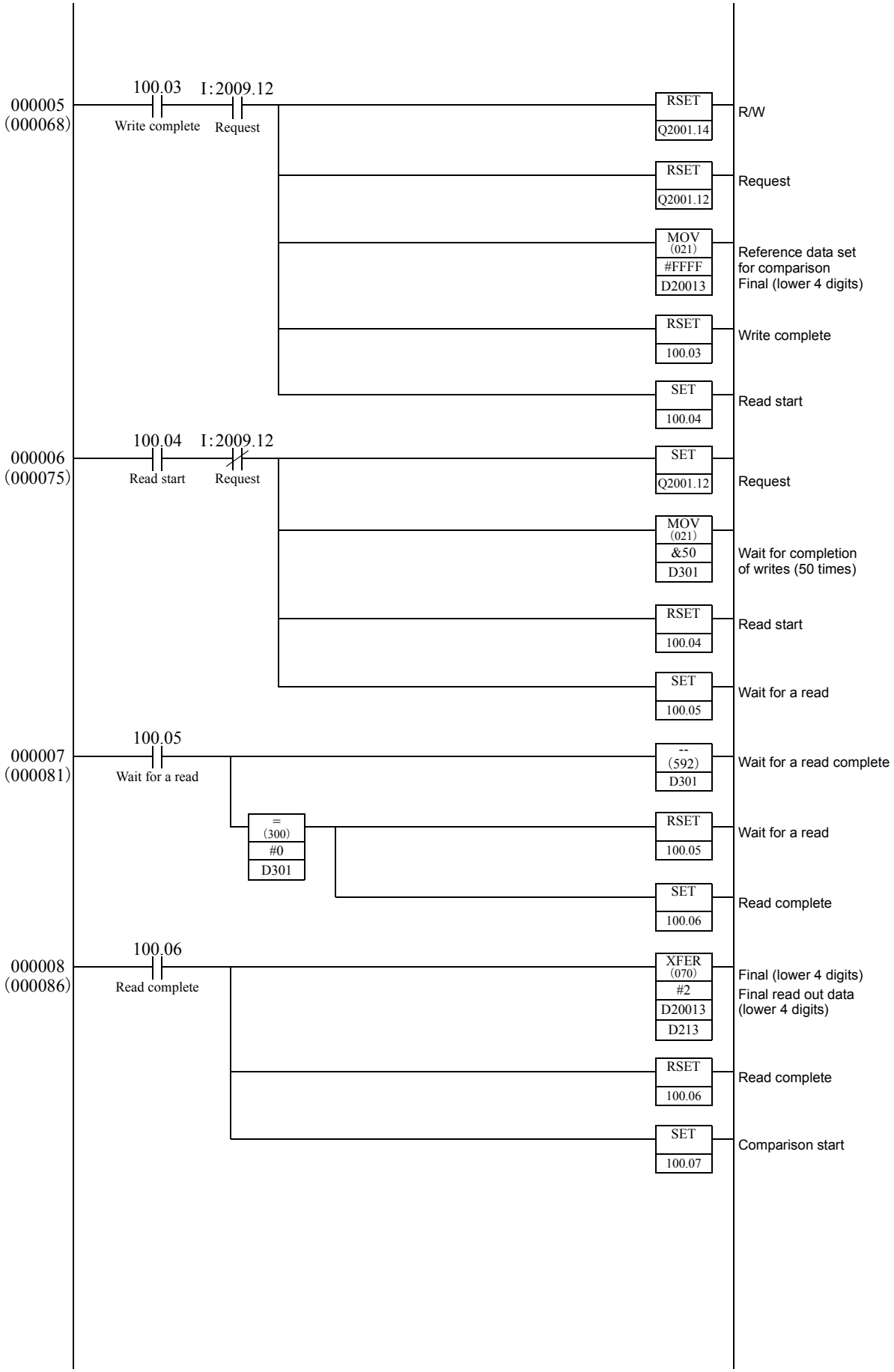
The following is a sample ladder program using a F159 (unit No.1) and CJ1 series. This program sets initial values to parameters required to carry out weighing process, and writes and reads Final using R/W and request signal.

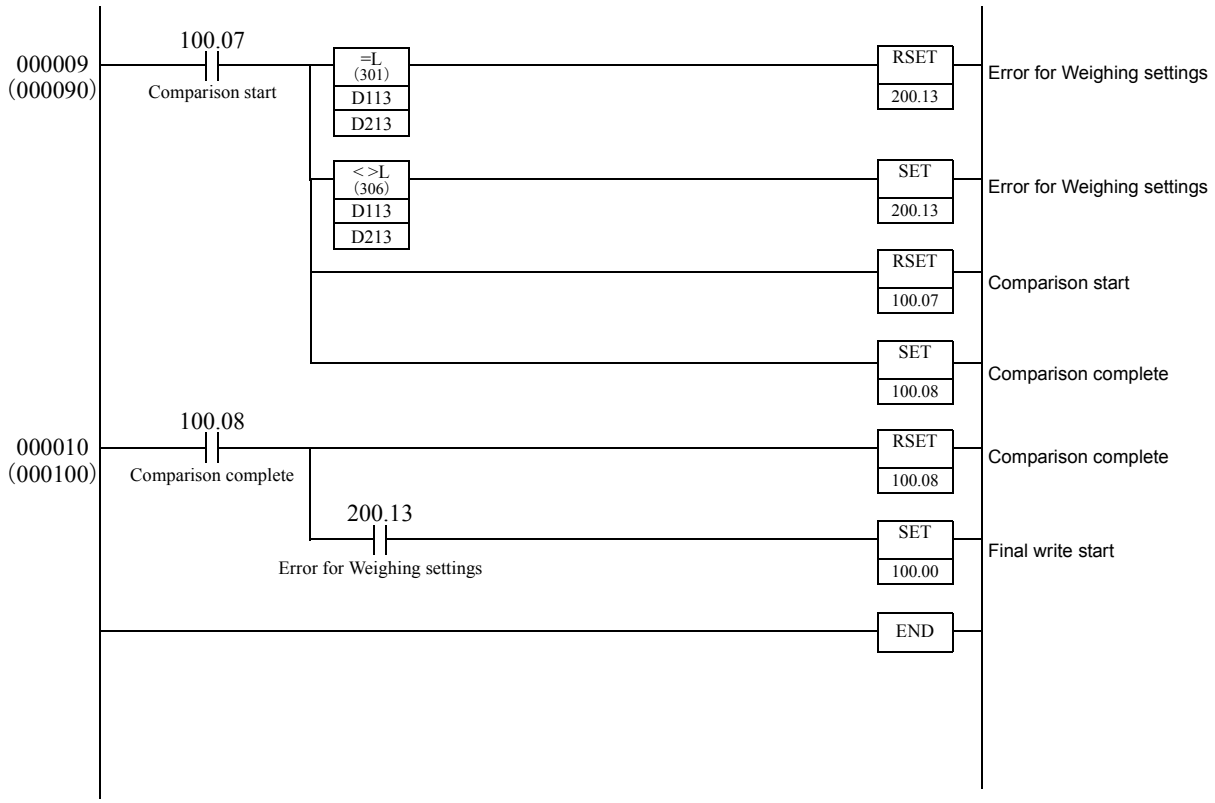



000001
(000018)
A200.11
P_First_Cycle
ON flag is set to allow
single cycle execution
MOV (021) #0 D20013
Final (lower 4 digits)
MOV (021) #0 D20014
Final (upper 1 digit)
MOV (021) #0 D20015
Preset tare value (lower 4 digits)
MOV (021) #0 D20016
Tare set value (upper 1 digit)
MOV (021) #0050 D20020
Initial settig write
Compariton Inhibit Time
MOV (021) #0150 D20021
Compare time
MOV (021) #0300 D20022
Complete output time
MOV (021) #0100 D20023
Auto jog timer
MOV (021) #0101 D20024
AZ times/Judging times
MOV (021) #9800 D20025
FF CPS. regulation (lower 4 digits)
MOV (021) #0000 D20026
FF CPS. regulation (upper 1 digits)
MOV (021) #0000 D20027
Weighing function 1
MOV (021) #0000 D20028
Weighing function 2
MOV (021) #0141 D20029
Weighing function 3
MOV (021) #0012 D20030
Output selection
MOV (021) #0000 D20031
Restriction on tare subtraction


MOV (021)
#0000
D20032
Sequence mode
MOV (021)
#1505
D20033
Motion detection
MOV (021)
#0000
D20034
Zero tracking (Period)
MOV (021)
#0000
D20035
Zero tracking (Range)
MOV (021)
#2064
D20036
Filter
MOV (021)
#0011
D20037
Stable mode
MOV (021)
#0021
D20038
Function selection
MOV (021)
#0000
D20039
Balance weight (lower 4 digits)
MOV (021)
#0001
D20040
Balance weight (upper 1 digit)
MOV (021)
#0000
D20041
Capacity (lower 4 digits)
MOV (021)
#0001
D20042
Capacity (upper 1 digit)
MOV (021)
#0001
D20043
Minimum scale division
MOV (021)
#9999
D20044
Net Over (lower 4 digits)
MOV (021)
#0009
D20045
Net Over (upper 1 digit))
MOV (021)
#9999
D20046
Gross Over (lower 4 digits)
MOV (021)
#0009
D20047
Gross Over (upper 1 digit)


MOV (021)
#0200
D20048
DZ regulation (lower 4 digits)
MOV (021)
#0000
D20049
DZ regulation (upper 1 digit)
MOV (021)
#0009
D20050
Gravitational acceleration (Area number)
MOV (021)
#9798
D20051
Gravitational acceleration (Acceleration)
000002
(000051)
100.00
Final write
XFER (070)
#2
D113
D20013
Final write data (lower 4 digits)
Final (lower 4 digits)
SET
Q2001.14
R/W
RSET
Q2001.12
Request
RSET
100.00
Final write start
SET
100.01
Final data set
000003
(000057)
100.01
Final data set
I:2009.12
Request
SET
Q2001.12
Request
MOV (021)
&50
D300
Wait for completion of writes (50 times)
RSET
100.01
Final data set
SET
100.02
Wait for write
000004
(000063)
100.02
Wait for writing
--
(592)
D300
Wait for completion of a write
=
(300)
#0
D300
RSET
100.02
Wait for a write
SET
100.03
Wait complete


000005
(000068)
100.03
Write complete
I:2009.12
Request
RSET
Q2001.14
R/W
RSET
Q2001.12
Request
MOV
(021)
#FFFF
D20013
Reference data set
for comparison
Final (lower 4 digits)
RSET
100.03
Write complete
SET
100.04
Read start
000006
(000075)
100.04
Read start
I:2009.12
Request
SET
Q2001.12
Request
MOV
(021)
&50
D301
Wait for completion
of writes (50 times)
RSET
100.04
Read start
SET
100.05
Wait for a read
000007
(000081)
100.05
Wait for a read
--
(592)
D301
Wait for a read complete
=
(300)
#0
D301
RSET
100.05
Wait for a read
SET
100.06
Read complete
000008
(000086)
100.06
Read complete
XFER
(070)
#2
D20013
D213
Final (lower 4 digits)
Final read out data
(lower 4 digits)
RSET
100.06
Read complete
SET
100.07
Comparison start



Request

To repeat the scan 50 times, this program uses decrement counters (step 000004 and 000007) for counting “Write complete” and “Read complete”.

To trigger FINS command for exchanging data with CPU unit, F159 sends “Request” bit to CPU. This is required because no flag is available that directly indicates the completion of data exchange by the FINS command. In this method, iteration number of scans can be affected by the time required by other processes: ample time should be allocated to avoid scan number fluctuation.

This ladder diagram is meant to show you the idea how to create your own program, and is not guaranteed to operate properly in all system.

Address Map for the Sample Ladder Diagram

Address	Data Type	Comment	Note
100.00	BOOL	Final data write start	Used for sequece control of sample ladder
100.01	BOOL	Final data set	
100.02	BOOL	Wait for a write	
100.03	BOOL	Write complete	
100.04	BOOL	Start to read	
100.05	BOOL	Wait for a read	
100.06	BOOL	Read complete	
100.07	BOOL	Start comparison	
100.08	BOOL	Comparison complete	
200.13	BOOL	Final setting error	For read/write error detection
2001.12	BOOL	Request	F159 relay area
2001.14	BOOL	R/W	
2009.12	BOOL	Request	
D113	CHANNEL	Final write data (lower 4 digits)	Write data
D213	CHANNEL	Final read data (lower 4 digits)	Read data
D300	CHANNEL	Wait for write complete	Used as a wait time counter
D301	CHANNEL	Wait for read complete	
D20000 ≀ D20051	CHANNEL		DM area for allocating F159's weighing settings and initial setting data

8. SETTING VALUES LIST

Weighing Setting Data

DM Area Address	Name	Initial Value	Refer to:
m , m+1	Upper limit	00000	P. 79
m+2 , m+3	Lower limit	00000	P. 79
m+4 , m+5	Near zero	00000	P. 79
m+6 , m+7	Set point 1	00000	P. 78
m+8 , m+9	Set point 2	00000	P. 78
m+10	Free fall compensation	0000	P. 78
m+11	Over	000	P. 78
m+12	Under	000	P. 78
m+13 , m+14	Final	00000	P. 78
m+15 , m+16	Preset tare value	00000	P. 57
m+17 - m+19	Undefined		

m= D20000 + Unit NO. × 100

Initial Data

DM Area Address	Name	Initial Value	Refer to:
m+20	Comparison inhibit time	050	P. 82
m+21	Compare time	150	P. 82
m+22	Complete output time	300	P. 82
m+23	Auto jog timer	100	P. 83
m+24	AZ times / Judging times	0101	P. 83
m+25 , m+26	FF CPS. regulation	09800	P. 75
m+27	Weighing function 1	0000	P. 31
m+28	Weighing function 2	0000	P. 32
m+29	Weighing function 3	0141	P. 33
m+30	Output selection	12	P. 34
m+31	Restriction on the tare subtraction function	0000	P. 34
m+32	Sequence mode	0000	P. 35
m+33	Motion detection	1505	P. 52
m+34	Zero tracking (Period)	00	P. 54
m+35	Zero tracking (Range)	0000	P. 54
m+36	Filter	2064	P. 50
m+37	Stable mode	11	P. 36
m+38	Function selection	21	P. 36
m+39 , m+40	Balance weight value	10000	P. 40
m+41 , m+42	Capacity	10000	P. 40
m+43	Minimum scale division	001	P. 41
m+44 , m+45	Net Over	99999	P. 87
m+46 , m+47	Gross Over	99999	P. 87
m+48 , m+49	DZ regulation value	00200	P. 55
m+50	Gravitational acceleration (Area Number Input)	0009	P. 41
m+51	Gravitational acceleration (Acceleration Input)	9798	P. 41
m+52 - m+99	Undefined		

m= D20000 + Unit NO. × 100

9. ERROR CODE

9-1. Error Code and Error Assistance Code

The Error Code contains error related to: calibration error, weight error (LOAD, OFL, or Zero Error), and sequence error. In error free state, both of these two registers are set to “0”.

Error Assistance Code indicates the type of error: “1” for calibration errors, “2” for weight errors, and “3” for sequence errors.

Error codes are summarized in the table below.

If multiple of errors occur simultaneously, smaller number of Error Code and Error Assistance Code has the priority.

Calibration Error (Error Assistance Code =1)

Name	Description	Error Code
Calibration Error 1	Zero calibration must be performed again	1
Calibration Error 2	Initial Tare value exceeds the F159’s zero adjustable range	2
Calibration Error 3	Initial Tare value is in negative territory	3
Calibration Error 4	Balance weight is larger than Capacity	4
Calibration Error 5	Balance weight is set to zero “00000”	5
Calibration Error 6	Load cell output falls short of the Lower limit of span adjustable range	6
Calibration Error 7	Load cell output is in negative territory	7
Calibration Error 8	Load cell output exceeds the Upper limit of span adjustable range	8
Calibration Error 9	Calibration aborted due to widely fluctuating weight	9

Weight Error (Error Assistance Code =2)

Name	Description	Error Code
EXC ALM	Excitation voltage to the load cell falls below the rated value	1
+LOAD	A/D converter input over-range (to positive direction)	2
-LOAD	A/D converter input over-range (to negative direction)	3
OFL1	Net weight > Net Over set value	4
OFL2	Gross weight > Capacity + 9 × （Minimum scale division）	5
OFL3	Gross weight > Gross Over set value	6
Zero Error	Zero error	7

Sequence Error (Error Assistance Code =3)

Name	Description	Error Code
Sequence Error 1	Stop signal had been raised when the system tried to start weighing sequence	1
Sequence Error 2	Stop signal raised while a weighing sequence is underway	2
Sequence Error 3	Auto Zero is activated due to AZ countdown. The system enters into ZALM state	3
Sequence Error 4	Near zero signal was OFF when the system tried to start weighing sequence (depends on system setting)	4
Sequence Error 5	When the system tried to start a weighing sequence, the initial Weight was found larger than SP1 (depends on system setting)	5

* However, SP1 = Final − SP1

9-2. Error Description

9-2-1. Calibration Error

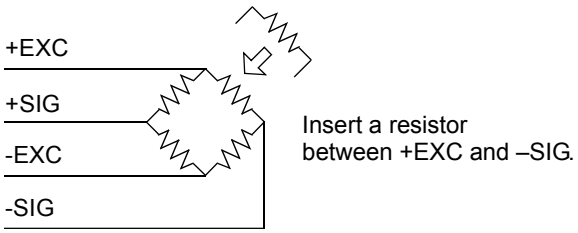
Calibration Error 1

Zero calibration must be performed again. In standard calibration procedures, Zero calibration is performed first, followed by Span calibration. However, if the result of the Span calibration is significantly off the target, F159 displays “Calibration Error 1”. If this happens you must perform Zero calibration. Correctly performed Zero calibration will clear the error message.

Calibration Error 2

Initial dead load exceeds the zero adjustable range of the F159. Check if the cell is loaded with any extra object.

If the **Calibration Error 2** persists while the system is loaded correctly, Zero calibration must be performed again after inserting a resistor between +EXC and –SIG terminals of the load cell for shifting zero point. The relation between input signal shift and resistor values are summarized in the table below.



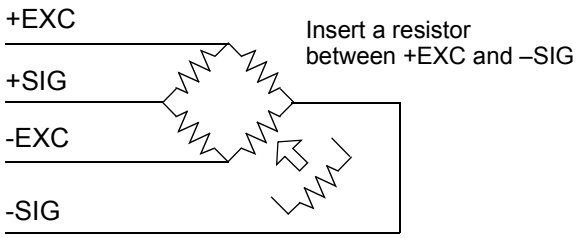
Resistor		Voltage shift equivalent strain	
Calculated	Approximate value	μ-STRAIN	mV/V
875 KΩ	866 KΩ	200	0.1
437 KΩ	442 KΩ	400	0.2
291 KΩ	294 KΩ	600	0.3
219 KΩ	221 KΩ	800	0.4
175 KΩ	174 KΩ	1000	0.5
146 KΩ	147 KΩ	1200	0.6
125 KΩ	124 KΩ	1400	0.7
109 KΩ	110 KΩ	1600	0.8
97 KΩ	97.6 KΩ	1800	0.9
87.3 KΩ	86.6 KΩ	2000	1.0
79.4 KΩ	78.7 KΩ	2200	1.1
72.7 KΩ	73.2 KΩ	2400	1.2
67.1 KΩ	66.5 KΩ	2600	1.3
62.3 KΩ	61.9 KΩ	2800	1.4
58.2 KΩ	57.6 KΩ	3000	1.5
54.5 KΩ	54.9 KΩ	3200	1.6
51.3 KΩ	51.1 KΩ	3400	1.7
48.4 KΩ	48.7 KΩ	3600	1.8
45.9 KΩ	46.4 KΩ	3800	1.9
43.6 KΩ	43.2 KΩ	4000	2.0
41.5 KΩ	41.2 KΩ	4200	2.1
39.6 KΩ	39.2 KΩ	4400	2.2
37.9 KΩ	38.3 KΩ	4600	2.3
36.3 KΩ	36.5 KΩ	4800	2.4
34.8 KΩ	34.8 KΩ	5000	2.5

- The values contained in the table assume single 350Ω load cell configuration.
- Temperature coefficient of the resistor directly affect reading accuracy. Use resistor with temperature coefficient better than 50ppm/ ℃ (5ppm/ ℃ class recommended)

Calibration Error 3

Initial dead load overshoots to negative range. Check if the cell is loaded in opposite direction, or +SIG and –SIG of the load cell are connected in reverse order.

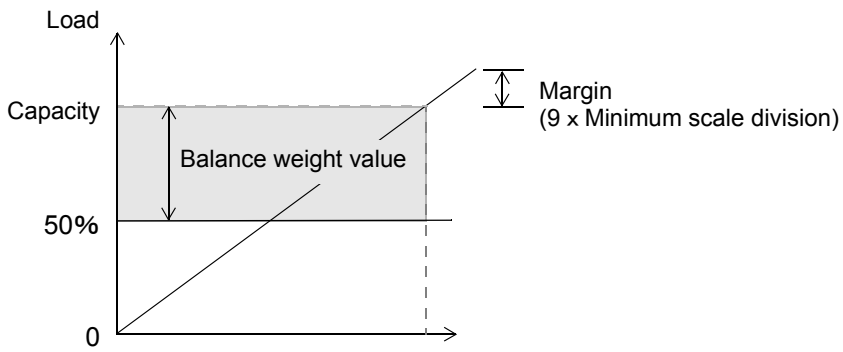
If Calibration Error 3 persists while load direction and cable connections are correct, Zero calibration must be performed again after inserting a resistor between +EXC and –SIG terminals of the load cell for shifting zero point. See the table in the previous section "Calibration Error 2" for determining the resistor to be inserted.



Calibration Error 4

Value set for Balance weight and/or Span calibration is larger than Capacity setting. Modify setting for Balance weight and/or Span calibration and retry Span calibration.

Capacity and Balance weight value



For accurate Span calibration, Balance weight value should be selected between 50%-100% of Capacity.

Calibration Error 5

Balance weight value is preset to “00000”. Select a proper non-zero value.

Calibration Error 6

The load cell output falls short of the F159’s allowable span adjustment range. Check if the load cell is loaded properly, and if its output specification meets F159 requirements. Then, perform Span calibration again.

Calibration Error 7

Load cell output varies in negative range. Check if the cell is loaded in opposite direction, or +SIG and –SIG of the load cell are connected in reverse order. Then, perform Span calibration again.

Calibration Error 8

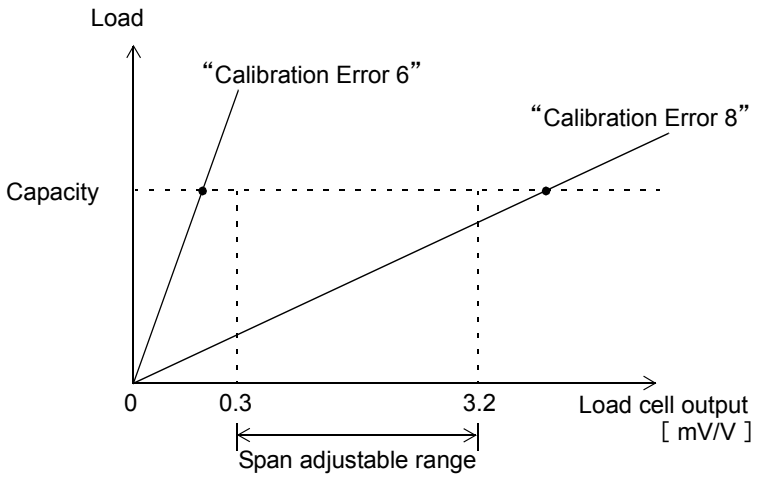
Load cell output is outside the F159’s allowable span adjustment range. Check if the load cell is properly loaded, and the its rated output falls within the F159’s span adjustable range. Perform Span calibration again. Then, perform Span calibration again.

Calibration Error 9

Calibration procedures have not completed because the reading of F159 widly fluctuated. Adjust parameters for stable readings (time, width) and make sure "stable" bit turns on, then perform calibration again.

Span adjustable range for F159 is from 0.3 to 3.2 (mV/V), within which the Span value should fall.

Therefore, if the load cell output for the maximus loadable weight (Capacity) falls short of 0.3 mV/V (Calibration Error 6) or exceeds 3.2 mV/V (Calibration Error 8), the Span calibration fails.



9-2-2. Weight Error

EXC ALM

The load cell excitatio voltage is too low. Check all the cables for proper connection between F159 and the load cell, and if any of the cables are overloaded.

+LOAD (A/D converter scale over)

Magnitude of signal from the load cell exceeds the F159's adjustable range. Check if the load cell output is properly within the range of Span calibration, or if any of the cables are broken. This error can also occur when the terminal block connections are all open.

-LOAD (A/D converter scale under)

Magnitude of signal from the load cell falls below the F159's adjustable range. Check if the load cell output is properly within the range of Span calibration, or if any of the cables are broken. This error can also occur when the terminal block connections are all open.

OFL1 (Net weight > Net Over)

Net weight is larger than the set value for Net Over. To restore normal weight display, reduce the signal from the load cell until OFL1 bit (10th bit of n+7 CH) turns off, or modify the set value for Net Over.

OFL2 (Gross weight > Capacity + 9 scale division)

Gross weight is larger than Capacity + 9 scale division. To restore normal weight display, reduce the signal from the load cell until OFL2 bit (11th bit of n+7 CH) turns off

OFL3 (Gross weight > Gross Over)

Gross weight is larger than the set value for Gross Over. To restore normal weight display, reduce the signal from the load cell until OFL3 bit (12th bit of n+7 CH) turns off, or modify the set value for Gross Over.

Request

Maximum load (Capacity) is one of the most fundamental parameters for F159 to perform properly as a metering instrument. Modification of Capacity entails re-calibration of the system. Care should be taken to prevent accidental modification of this value when you are correcting OFL2 error.

9-2-3. Sequence Error

Sequence Error 1

This error occurs when you try to start measuring sequence (Start signal turned ON) while Stop signal is still ON. Remove this error by changing stop signal OFF → ON → OFF, then re-start weighing sequence with the stop signal OFF.

Sequence Error 2

Sequence Error 2 occurs when stop signal turns on while a measuring process using sequence control is underway. Change the stop signal from OFF to ON to remove the error.

Sequence Error 3

Sequence error 3 occurs when the system falls into the state of ZALM while it is performing auto zero in using sequence control.
To clear ZALM, remove the cause of zero shift (adherence of foreign object, etc.) and reset Digital Zero.
Change stop signal from OFF to ON to remove the sequence error.

Sequence Error 4

This error occurs when you try to start measuring sequence (Start signal turned ON) while Near zero signal is still OFF “0”. (Note that you can select a setting to ignore Near zero when the sequence starts.)
First, check the relation between the set value for Near zero and the reference for comparison, and then check the following:

・Sequence started prematurely while material still remains in the metering tank

・Start turned ON prematurely

・Material can not be discharged properly, due to valve blockage, etc.

Change stop signal from OFF to ON to remove the sequence error.

Sequence Error 5

This error occurs when you try to start measuring sequence while Set point 1 signal is still ON “1”. (Note that you can select a setting to ignore Weight when the sequence starts.)

First, check the relation between the set values for SP1 and Final, and then check the following:

・Sequence started prematurely while material still remains in the metering tank

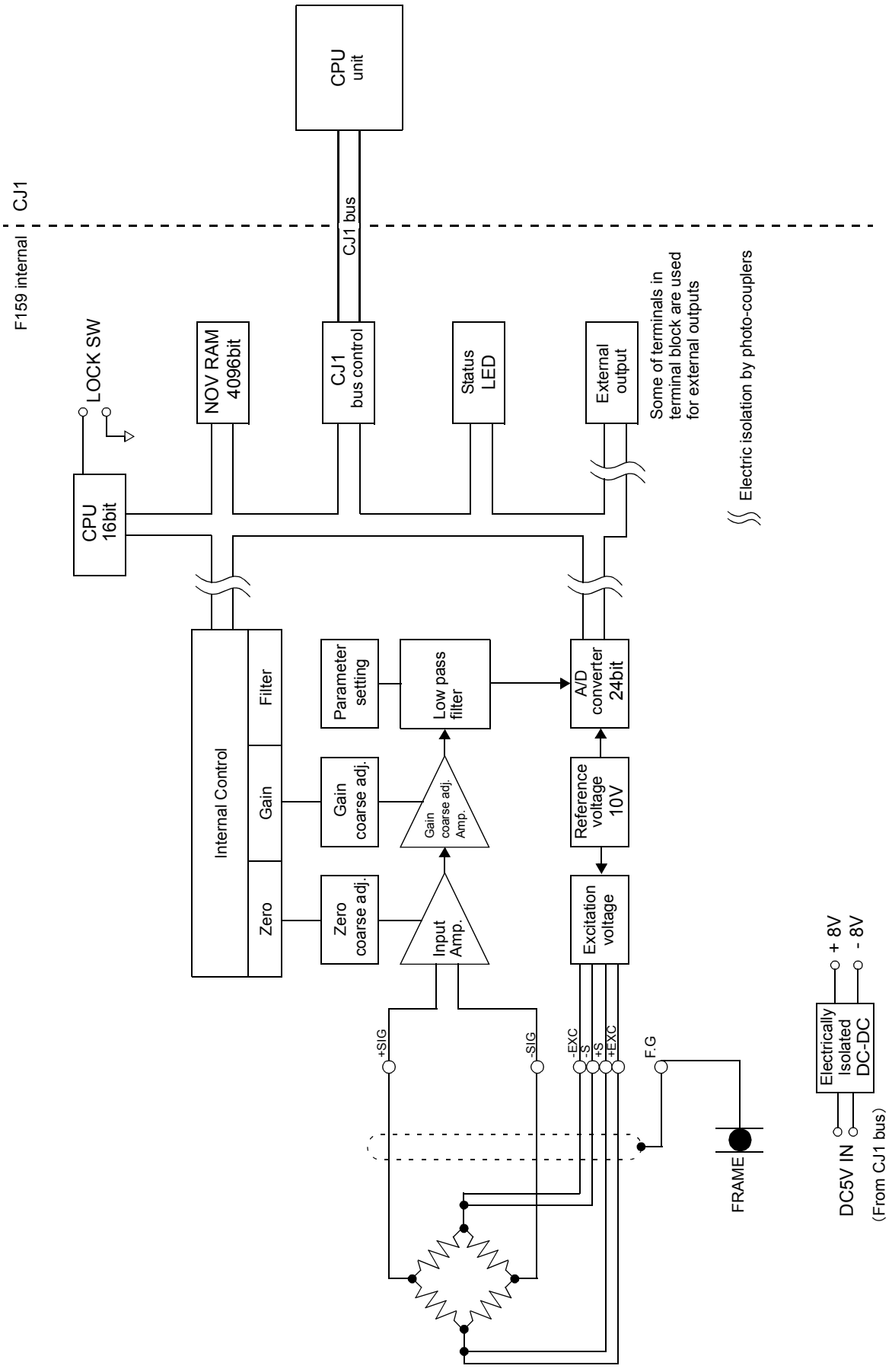
・Start turned ON prematurely

・Material can not be discharged properly, due to valve blockage, etc.

Change stop signal from OFF to ON to remove the sequence error.

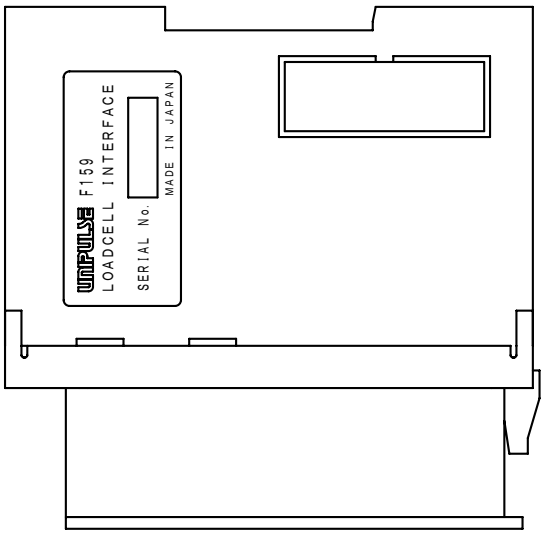
For detailed description of the course of sequence control, see Section 6-2. "Simple Comparison Control and Sequence Control" , page67.

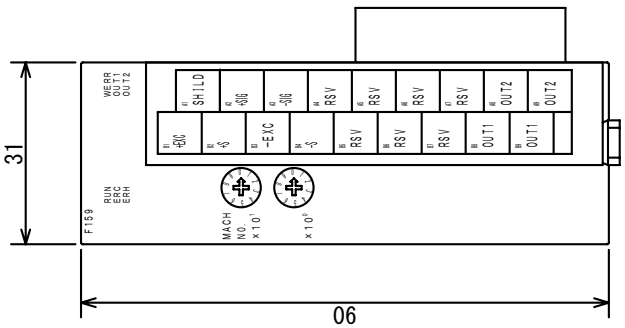
10. BLOCK DIAGRAM

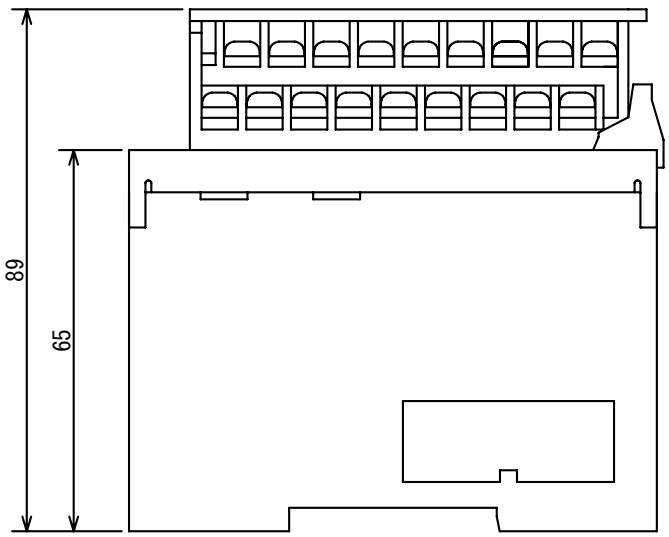


11. DIMENSIONS

Unit: mm





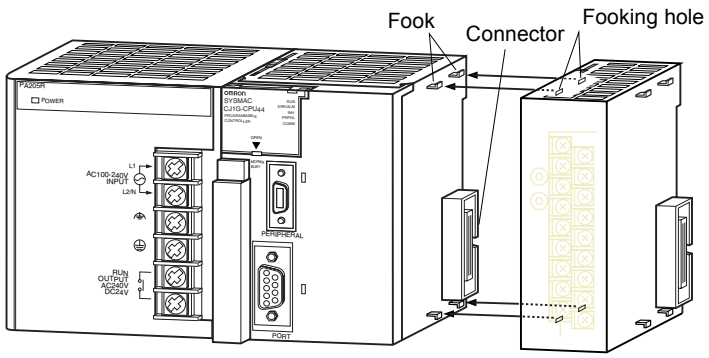


12. INSTALLATION

12-1. Connection with CJ1 Unit

Multiple of CJ1 units can be connected by simply engaging connectors and locking the slider. Add an end cover to the unit installed to the right most unit.

1 Engage the connector properly to connect units.

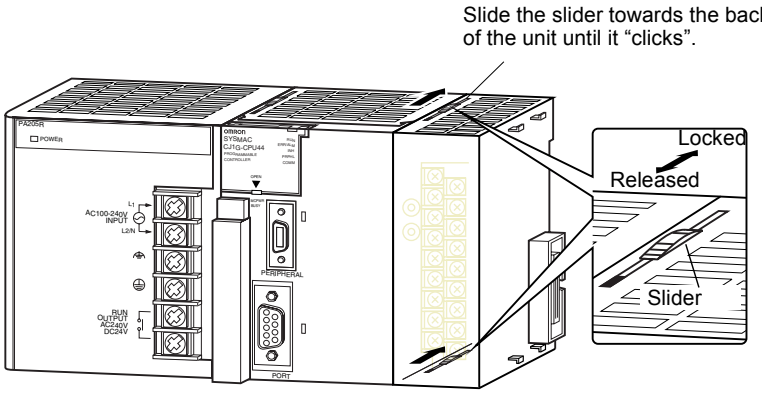


CJ series do not require base unit. Each unit can be connected to each other using the integrated side-mount connector.

⚠ CAUTION

- Never fail to turn off the system before starting system assembly.
- When replacing a unit, remove the assembled unit as a whole before replacing one of them.

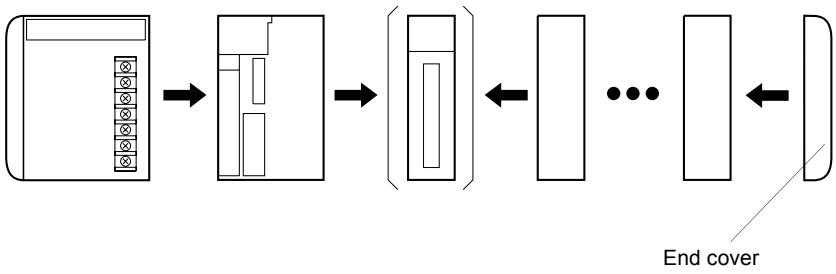
2 Slide the two yellow sliders on the upper and lower end of the unit until they "clicks" to lock securely.



⚠ CAUTION

Lock the unit securely by moving the slider to its full stroke. Insufficient engagement can hinder the system from proper operation.

3 Add an end cover to the right most unit.



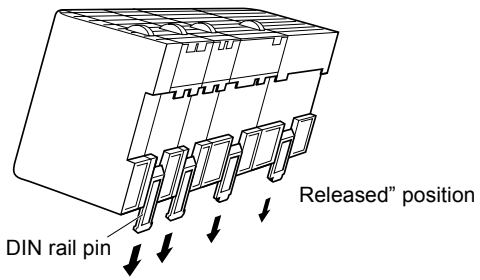
⚠ CAUTION

You must install an end cover to the right most units. Without it, CJ1's CPU unit issues "I/O bus error" (Operation Halt Error) and will not start operation (neithre "operation" nor "monitoring" mode).

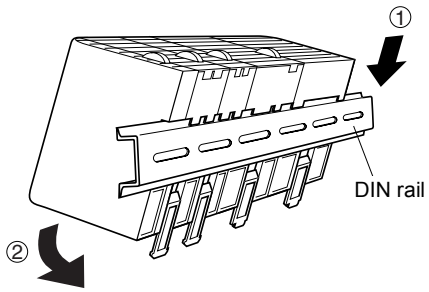
12-2. DIN Rail Installation

CJ series can only be mounted to DIN type rail. It can no be installed using screws.

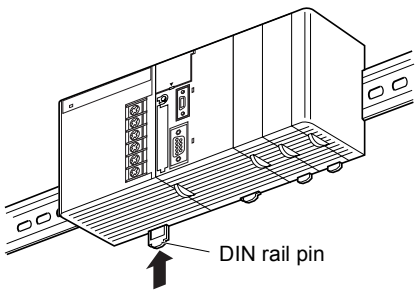
1 Set the DIN rail pins on the rear of the unit to "Released" position.



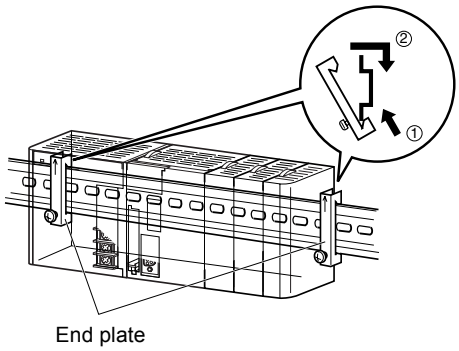
2 Hook the CJ unit's upper protrusions on the DIN rail (①), and engage the entire notch to the rail (②).



3 Lock all the DIN rail pins by pushing upwards.



4 Secure the unit by installing a end plate.



To fix CJ1 assembly securely, sandwitch the assembly using a pair of endplates from both sides. Fook lower notch of the end plate to the lower plate of the rail (①), and then engage the upper notch, then pull the end plate to lower direction (②). Tighten the screw to fix them serurely.

Request

For details on the handling of CJ series units, see “OMRON CJ Series: CJ1/CJ1-H/CJ1M CPU Unit User’s Manual (Setup)” provided by OMRON.

13. SPECIFICATIONS

13-1. Analog Section

Input	6-wire input (+EXC, +S, -S, -EXC, SHIELD, +SIG, -SIG), remote sensing
Load cell source	DC10V ± 5%, source current max.120 mA (up to four 350Ω load cells can be connected in parallel)
Zero adjustment	0-2 mV/V Coarse: Digital control using the coarse adjustment circuit Fine: Automatic adjustment using digital calculation
Span adjustment	0.3-3.2 mV/V Coarse: Digital control using the coarse adjustment circuit Fine: Automatic adjustment using digital calculation
Max. sensitivity	0.3 μV/count
Auuracy	Linearity error: <0.01% FS (Typ. 0.005% FS, room temperature) Zero drift: <0.2 μV/℃ RT1 （Typ. 0.15 μV/℃） Gain drift: < 15ppm/℃ (Typ. 5 ppm/℃)
Analog filter:	Bessel type low-pass filter (-12dB/oct) Cut off frequency selectable from 2, 4, 6, 8 Hz
A/D converter	ΔΣ method converter conversion rate: 500/sec resolution: 24 bit (binary)
Display resolution	1/10000 (1/4 scale division enabled) 1/40000 (1/4 scale division disabled)

13-2. Display

Front panel LED

RUN
ERC
ERH

Turns on when an error in initial settings, CPU related error, and unit error is detected (compliant to CJ1 specification).

WERR Turns on when Weight Error status turns ON.

OUT1 OUT1 status turns ON.

OUT2 OUT2 status turns ON.

Terminal layout

+EXC	B1	A1	SHILD
+S	B2	A2	+SIG
-EXC	B3	A3	-SIG
-S	B4	A4	RSV
RSV	B5	A5	RSV
RSV	B6	A6	RSV
RSV	B7	A7	RSV
OUT1	B8	A8	OUT2
OUT1	B9	A9	OUT2

13-3. Setting

Unit No. rotary switch

Selects a unit number for the high performance I/O unit: 0-95

DIP switch Lock function

Set value Inported from CJ1

Set value storage Initial values NOV RAM (non-volatile RAM)

Set value protection Modificatio of set values can be inhibited to procect them from accidental change (LOCK)

Setting item

- Upper limit / Lower limit /Near zero / SP2 / FF CPS. / Over / Under / Final / Tare
- Comparison inhibit time/Compare time/ Complete output time/Auto jog timer / Auto zero times / Judging times /FF CPS. regulation / Weighing function 1 (Weighing mode, Over/Under comparison, Upper/Lower limit comparison, Near zero comparison) / Weighing function 2 (Over/Under comparison mode, Upper/ Lower limit comparison mode, Complete Signal Output mode, Sign convention for discharge control) / Weighing function 3 (FF CPS. coefficient, FF CPS., Average count of FF CPS., Digital tare subtraction)/ Output selection (Mode selection, Auto jog, At start NZ confirmation, At start weight value confirmation)/ Motion detection (period, range) / Zero tracking (period) / Zero tracking (range) / Filter (Analog filter, Digital filter) / Stable mode (Digital filter 2, Motion detection mode) / Function selection (Decimal place, 1/4 scale division) / Balance weight / Capacity / Minimum scale division / Net Over / Gross Over / DZ regulation / Gravitational acceleration (Area number) / Gravitational acceleration (Acceleration)
- Zero calibration / Span calibration / Tare subtraction / Tare subtraction reset / Digital Zero / Digital Zero reset

13-4. General Specifications

Power consumption

350Ω load cell:
Approx. 300 mA (single load cell)
- Approx. 700 mA (four cells in parallel)

Environment

Temperature: Operational	0℃ - +55℃
(accuracy compensation applicable:	0℃ - +40℃)
Storage:	-20℃ - +75℃

Humidity：< 90%RH (non-condensing)

Dimensions

31 (W) × 90 (H) × 65 (D) mm (protrusions excluded)

Weight

Approx. 150g