YAMATAKE Specification

TDC 3000 SSC II
Programmable Controller
Model KAM 111/211

Introduction

The TDC 3000 Single Strategy Controller II (SSC II) is a high-performance microprocessor-based controller. A compact instrument with PID control and various auxiliary functions, it provides loop control in single-loop units.

Features

- Multiple inputs, outputs and computational functions.
- High-precision operational control functions.
- Self-tuning functions.
- Parameter scheduling functions.
- Self-diagnostic functions.
- Auto-balance function.
- Standardized input processing functions (temperature/pressure compensation, square-root extraction, linearization and filtering).

Operation

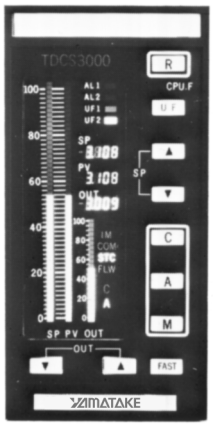
- Simultaneous bar graph (in color LCD) and digital value displays.
- User-defined key function.
- Parameter/reference display changes easily made on the side of the instrument.

Engineering support tool

- Easy configuration and simulation through interaction with personal computer.
- Configuration data changes in the field done with dedicated SSC II Handy Communicator.

Standards met

- Panel dimensions comply with IEC regulations.



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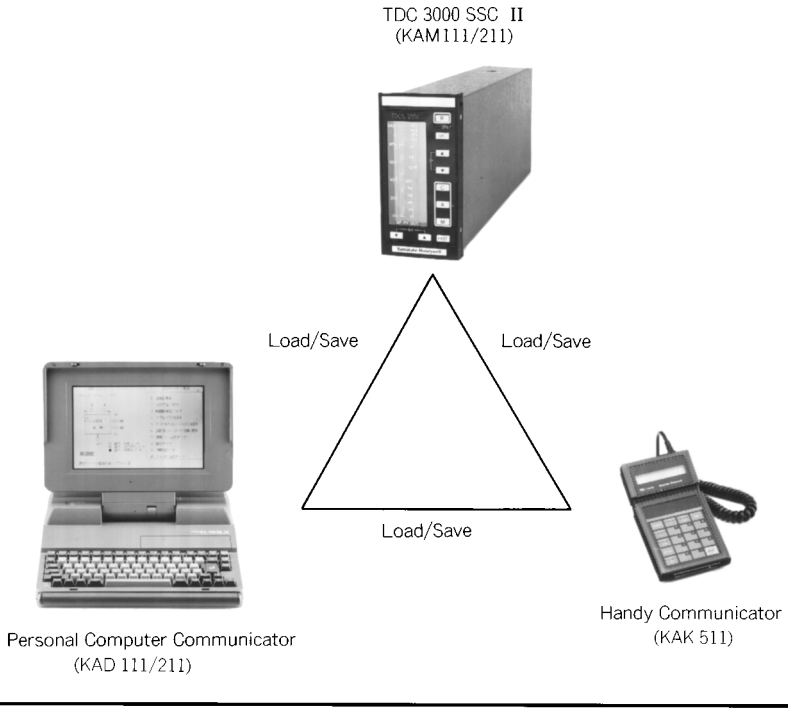
Engineering configuration diagram



Functional structure

The Programmable Controller has 50 computational units and 94 algorithms. By assigning appropriate algorithms to respective computational units and connecting them as required the user can realize advanced control functions.

Number of computational units : 50
Number of algorithms : 94
Variable parameters : %····· 40
Time ····· 10
Flag ····· 10
Fixed parameters : Unlimited number
Linearization table : 6
(6 tables connectable)
%→% table····· 4
%→Time table····· 4
1 table····· 11 segments

Functions of the Programmable Controller are defined by inputting the following configuration data.

Basic data :
Selects type of control, scan frequency, and other basic items of Programmable Controller operation.

Input processing data :
Selects input processing functions.

Computational unit data :
Selects algorithms to be used and connections of computational units.

Characterizing data :
Data of linearization table (data on segments).

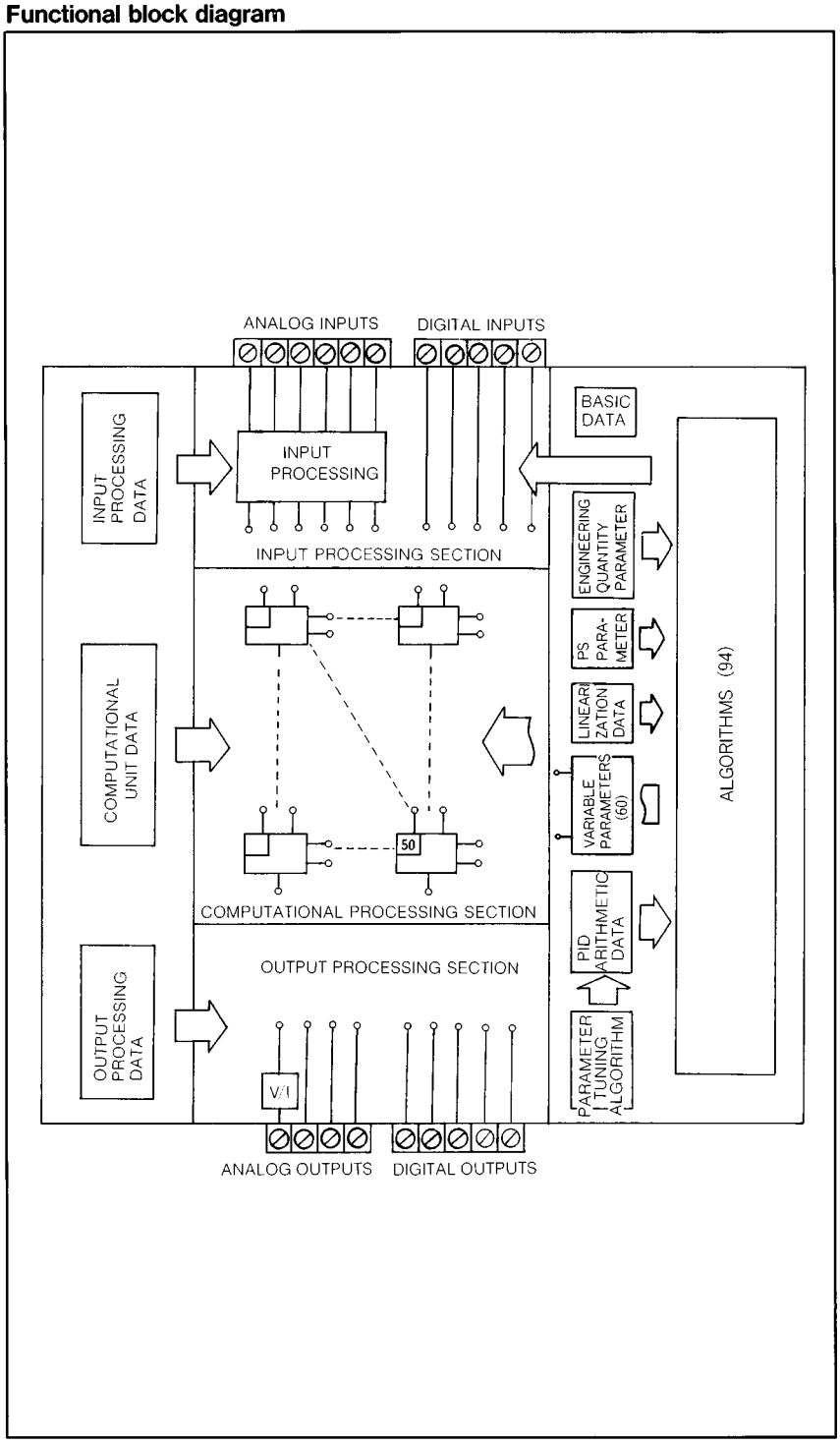
PID computation data :
Selects data on control parameters for PID algorithms.

Output processing data :
Selects data to dictate output signals.

PS parameter :
Selects table number used in parameter scheduling, and selects rate of change limit.

Engineering quantity parameter :
Selects upper, lower limit used in DDM unit, and selects decimal point position.

Functional block diagram



Input processing functions

The Programmable Controller is capable of accepting and processing six analog inputs as illustrated. They are as follows :

- Approximation by linearization table
- Temperature compensation
- Pressure compensation
  [Non-SI units (kgf/cm² etc.) and SI units (Pa : Pascal) are available.]
- Square-root extraction
- Digital filtering
- Input alarm detection

Self-tuning function

This function is based on Yamatake Corporation unique "Advanced Loop Tuning" method. Since tuning is continuously performed with a closed loop, there is no process instability.

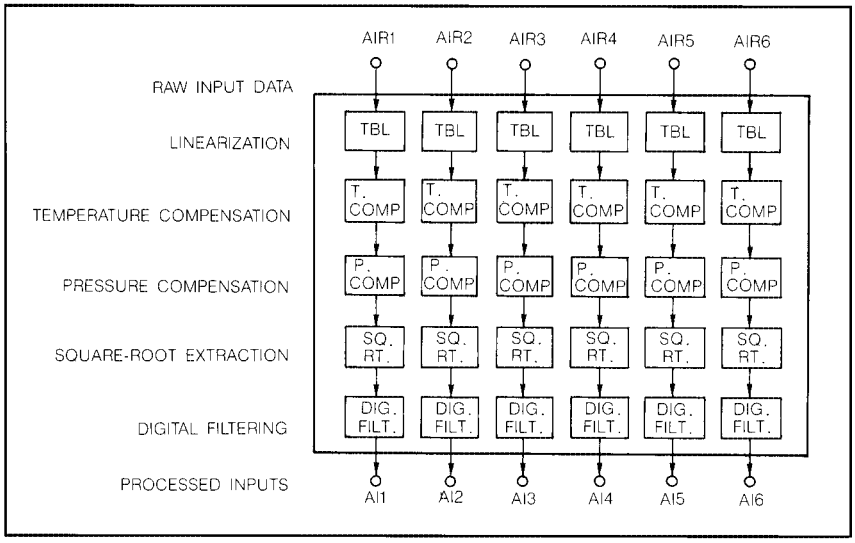
- Automatic tuning by monitoring the process.
- Tuning as requested by the operator.
- Selectable : fixed or cascade control

Parameter scheduling function

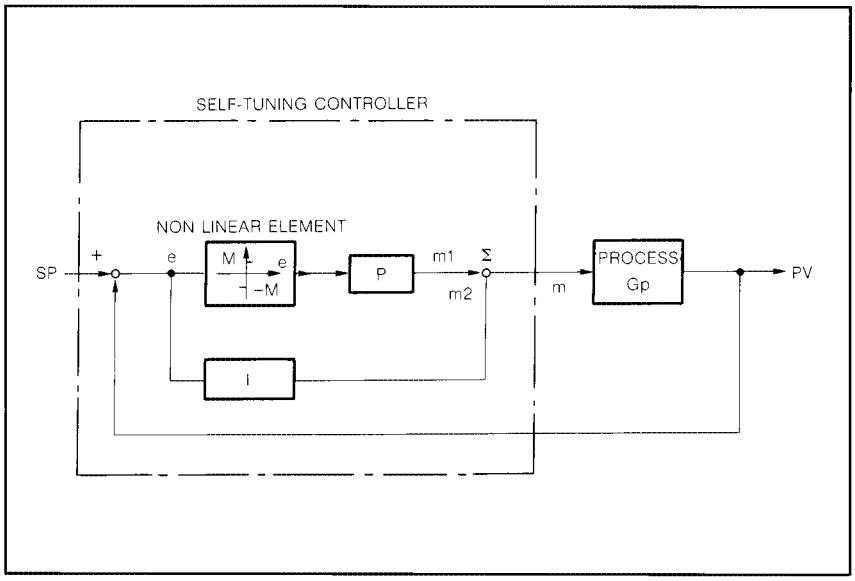
This function realizes optimum controllability for a wide range of load change by automatically transferring PID parameters.

This function is applicable for predicted process characteristics due to load or control quantity change in non-linear process.

Input processing functions



Advanced loop tuning block diagram



Algorithms

No.	Algorithms		Description	No.	Algorithms		Description
	Name	Symbol			Name	Symbol	
1	Addition	ADD	OUT=P1∗H1+P2∗H2	50	Reverse Linearization Table # 5	TBR5	Reverse function of Linearization table #5.
2	Subtraction	SUB	OUT=P1∗H1−P2∗H2	51	Reverse Linearization Table # 6	TBR6	Reverse function of Linearization table #6.
3	Multiplication	MUL	OUT=H1∗H2	52	SP Indication Switching	SPSW	SP Indication switching unit
4	Division	DVD	OUT=H1/H2+P1	53	PV Indication Switching	PVSW	PV Indication switching unit
5	Absolute Value	ABS	OUT=|H1|	54	OUT Indication Switching	OUTSW	OUT Indication switching unit
6	Square-Root Extraction	SQR	OUT=$\sqrt{H1}$	55	Mode Switching*1 (edge detection)	MODX	Switching M/A/C/F mode
7	Maximum Value	MAX	OUT=MAX(H1,H2,P1,P2)	56	—	—	—
8	Minimum Value	MIN	OUT=MIN(H1,H2,P1,P2)	57	—	—	—
9	4-point Addition	SGM	OUT=H1+H2+P1+P2	58	Alarm Lamp Output # 1	AL1	Alarm lamp output control unit #1
10	High Selector	HSE	OUT=HI Select(H1,H2)	59	Alarm Lamp Output # 2	AL2	Alarm lamp output control unit #2
11	Low Limiter	LLM	Limiting at low limit value(H2)	60	User Lamp Output # 1	UF1	User lamp output control unit #1
12	Low Selector	LSE	OUT=LO Select(H1,H2)	61	User Lamp Output # 2	UF2	User lamp output control unit #2
13	High Limiter	HLM	Limiting at high limit value(H2)	62	Time→% Conversion	TTP	OUT=(H1−P1/P2−P1)∗100
14	High Monitor	HMS	Output turned on when higher than Hi monitor value(H2)	63	%→Time Conversion	PTT	OUT=H1∗(P2−P1)+P1
15	Low Monitor	LMS	Output turned on when lower than Lo monitor value(H2)	64	—*1	—	—
16	Deviation Monitor	DMS	Output turned on when higher than deviation monitor value(H2)	65	—*1	—	—
17	Deviation Rate Limit	DRL	Deviation rate limited within H2 or −P1%/minute.	66	Integral Unit*1	INT	OUT=H1/(P1・S)
18	Deviation Rate Monitor	DRM	Output turned on when deviation rate is more than H2 or −P1%/minute.	67	Parameter Scheduling # 1*1	PS1	Changes control parameter according to load input.
19	Manual Output	MAN	Operation with manual loader	68	Parameter Scheduling # 2*1	PS2	Changes control parameter according to load input.
20	Controller # 1	PID1	PID Control with self-tuning function	69	Parameter Scheduling # 3*1	PS3	Changes control parameter according to load input.
21	Controller # 2	PID2	PID Control with self-tuning function	70	Parameter Scheduling # 4*1	PS4	Changes control parameter according to load input.
22	Dead Time	DED	OUT=e^{-pls}∗H1	71	Parameter Scheduling # 5*1	PS5	Changes control parameter according to load input.
23	Lead/Lag	L/L	OUT=(1+P1S)/(1+P2S)∗H1	72	Parameter Scheduling # 6*1	PS6	Changes control parameter according to load input.
24	Derivative	LED	OUT=P1S/(1+P2S)∗H2	73	% → % Table # 1 *1	PTB1	% → % Table #1(11 breaking points)
25	Moving Average	MAV	OUT=$\frac{1}{16}\sum_{i=0}^{15}H1(\frac{i}{15}P1)$ (H1=Input at P1 minutes ago)	74	% → % Table # 2 *1	PTB2	% → % Table #2(11 breaking points)
26	Flip-Flop	RS	RS flip-flop	75	% → % Table # 3 *1	PTB3	% → % Table #3(11 breaking points)
27	Logical Product	AND	OUT=H1∧H2∧P1∧P2	76	% → % Table # 4 *1	PTB4	% → % Table #4(11 breaking points)
28	Logical Sum	OR	OUT=H1∨H2∨P1∨P2	77	% → Time Table # 1 *1	TTB1	% → Time Table #1(11 breaking points)
29	Exclusive Logical Sum	XOR	OUT=H1⊻H2	78	% → Time Table # 2 *1	TTB2	% → Time Table #2(11 breaking points)
30	Invert	NOT	OUT=$\overline{H1}$	79	% → Time Table # 3 *1	TTB3	% → Time Table #3(11 breaking points)
31	2-Position Transfer Switch	SW	H1/H2 selector switch	80	% → Time Table # 4 *1	TTB4	% → Time Table #4(11 breaking points)
32	Bumpless Transfer Switch	SFT	Switching with bump suppression.	81	Alternate Switch*1	ALSW	Reversing output at H1=ON
33	Timer	TIM	Pulse generation per P1 minutes.	82	Time Switch*1	TSW	Selection switches H1,H2 (Time)
34	Integration Pulse Output	CPO	Pulse number output proportional to input H2.	83	Flag Switch*1	FSW	Selection switches H1,H2 (Flag)
35	Ramp Signal Generation	RMP	Output increase at constant rate.	84	On Delay Timer*1	ONDT	Output turned ON after P1 time at H1=ON.
36	Pulse Width Modulation	PWM	Pulse output with duty ratio proportional to input H1, with period P1.	85	Off Delay Timer*1	OFDT	Output turned OFF after P1 time at H1=OFF.
37	Linearization Table # 1	TBL1	Linearization table #1(10 breaking points)	86	One-shot Timer*1	OST	Output turned ON for P1 time at H1=ON.
38	Linearization Table # 2	TBL2	Linearization table #2(10 breaking points)	87	Hi/Lo Limiter*1	HLLM	Limiter activated at Hi(P1) or Lo(P2) value.
39	Linearization Table # 3	TBL3	Linearization table #3(10 breaking points)	88	Integration Pulse Output II	CPX	Pulse number output equivalent to integration range
40	Reverse Linearization Table # 1	TBR1	Reverse function of Linearization table #1.	89	Data Hold	HOLD	One cycle hold value output at startup
41	Reverse Linearization Table # 2	TBR2	Reverse function of Linearization table #2.	90	Raise/Lower Unit*1	RL	Output decreased or increased according to H1, or H2.
42	Reverse Linearization Table # 3	TBR3	Reverse function of Linearization table #3.	91	Reset Unit*1	RST	Resets interlock.
43	Control Parameter Change # 1	PMD1	Change of control of PID 1.	92	Digital Indication*1 Change # 1	DDM1	Changes digital indication #1.
44	Control Parameter Change # 2	PMD2	Change of control of PID 2.	93	Digital Indication*1 Change # 2	DDM2	Changes digital indication #2.
45	Mode Select (switch detection)	MOD	M/A/C/F mode change	94	Digital Indication*1 Change # 3	DDM3	Changes digital indication #3.
46	Linearization Table # 4	TBL4	Linearization table #4(11 breaking points)	95	Digital Indication*1 Change # 4	DDM4	Changes digital indication #4.
47	Linearization Table # 5	TBL5	Linearization table #5(11 breaking points)	96	Digital Indication*1 Change # 5	DDM5	Changes digital indication #5.
48	Linearization Table # 6	TBL6	Linearization table #6(11 breaking points)	97	Digital Indication*1 Change # 6	DDM6	Changes digital indication #6.
49	Reverse Linearization Table # 4	TBR4	Reverse function of Linearization table #4.	98	Display Change*1	DCHG	Changes display.

Note*1) No.55 & No.64 through 98 are not supported on PC Communicator (IBM-Compatible Version).

Standard specifications

Item				Description
Input Section	Analog Input		No.of inputs	7 points (programmable : 6, for stand-by PV input : 1)
			Input voltage	1 to 5V dc
			Input impedance	Power-on : 5MΩ, Power-off : 60kΩ
			Receiving system	Differential type receive, not isolated
			Allowable input overvoltage	±30V dc maximum
	Digital Input		No.of inputs	6 points (programmable : 5, external interlock signal : 1)
			Input voltage	Low : 0 to 4V dc, High : 10 to 30V dc
			Input bias current	Low : 3mA dc or less, High : 10μA dc or less
			Allowable input overvoltage	±30V dc maximum
Output Section	Analog Output	Voltage	No.of outputs	3 points
			Output voltage	1 to 5V dc
			Output impedance	250Ω
			Output system	Differential output system
		Current	No.of outputs	1 point
			Output current	4 to 20mA dc
			Output impedance	250kΩ
			Allowable load	500Ω (preset type), 600Ω (follow-up type or unit not mounted)
			Output system	Minus common
	Digital Output		No.of outputs	6 points (programmable : 5, stand-by mode output : 1)
			Output system	Transistor output (open collector)
			Contact rating	30V dc, 0.2A dc (resistive load)
Indicator Section	Input		No.of indications	2 points (SP : green, PV : red)
			Type of indicator	Simultaneous bar graph (% in color LCD) and digital value (engineering units) displays (bar graph : 53 segments, digital value : 7 segments (4 digits)
			Indicating accuracy	Digital indication : ±0.15% FS±1 digit, bar graph resolution : 2%
	Output		No.of indications	1 points (OUT : yellow)
			Indication system	Simultaneous bar graph (% in color LCD) and digital value (engineering units) displays (bar graph : 23 segments, digital value : 7 segments (4 digits)
			Indicating accuracy	Digital indication : ±0.25% FS ±1 digit, bar graph resolution : 5%
	Alarm		No.of indications	5 points (process alarm : 2, user lamp : 2, equipment alarm : 1)
			Indicating system	Color LCD and LED lamp
	Mode indication			Character indication by color LCD
Operating Section	Operation control buttons			SP raise/lower buttons : 2 Output raise/lower buttons : 2 SP, output raise/lower acceleration button : 1 Mode switch buttons : 3 Reset button : 1 Definitive buttons for user : 1
	Data Setter		Indicating method	LCD (16 digits)
			No.of setting buttons	24 (including display change button)
			Parameter tuning	PID Parameter Proportional band : 0.0 to 799.9% Reset time : 0.00 to 99.99min. Rate time : 0.00 to 99.99min. Reset upper/lower limit, Ratio, Bias, Dead band, Output deviation rate limit, Deviation alarm, PV alarm upper/lower limit, Analog input processing, Digital filtering, Engineering unit upper/lower limit Variable parameters % : −699.9 to 799.9% Time : 0.00 to 99.99min. Flag : On/off Parameters for self-tuning Proportional band upper/lower limit, Reset time upper/lower limit, Rate time upper/lower limit, Rate time dropout, Decision rule : Giegler-Nichols/Chien
	Auxiliary switches			Data entry enabling : 1 Start-up method switching : 1 Direct/reverse selectors : 2 Higher-order writing enabling : 1 Communication enabling : 1 Calibration switch : 1 Communicator switch : 1

General Specifications	Power supply	24V dc$^{+15\%}_{-10\%}$
	Power consumption	400mA dc maximum (24V dc. without option)
	Signal line connection	Instrument back-panel terminal connection. connecting line diameter : 1.25mm^2 maximum
	Power interruption/failure	16V dc or over, within 200 msec. (with STX type power supply) Data holding at power interruption ・User program : Backup by EEPROM ・Control data (SP.OUT.mode) : RAM backup by super capacitor (72 hours) Power failure reset function : ・HOT start (Operation resumes from prefailure status) ・COLD start (Operation starts from preset value)
	Ambient temperature	0 to 50℃
	Ambient humidity	10 to 90% RH
	Installation	Panel flush mount, indoor installation
	Mounting angle	Horizontal (Instrument back can be slanted 60 maximum from horizontal position.)
	Finish	Case : Dark beige Bezel : Black
	Weight	3.0kg (without standby manual unit)

Optional specifications

Item	Description
① Standby manual unit (Preset type／follow-up type)	No.of indications : 1 point (with OUT/PV switch ; A-type, preset B-type; without indication, follow-up B-type ; output only.) Indicating system : Moving coil type (A-type) LED bar graph type (follow-up type-B only) Indicating accuracy : ±5% FS Power supply : 24V dc Output impedance : 250kΩ Allowable load : Preset type ; 500Ω Follow-up type ; 600Ω Power consumption : Preset type ; 60mA maximum (24V dc) Follow-up type ; 120mA dc maximum (24V dc)
② Communication interface	S-link communication : 48k bits/sec. Transmission system : Complies with HDLC Transmission distance : 200m total Host : SSC Port,LCI

Model number table

Basic Model No.	Selections	Options			Description
	Main Power Supply	I	II	III	
KAM111					Programmable controller A/M, SP operation available (See Note)
KAM211					Programmable controller C/A/M, SP operation available (See Note)
	−0				24V dc
		−0			Without communication interface
		−1			With communication interface
			0		Without self-tuning function
			1		With self-tuning function
				0	Without standby manual unit
				1	With standby manual unit (preset type A)
				2	With standby manual unit (follow-up type A)
				3	With standby manual unit (preset type B)
				4	With standby manual unit (follow-up type B)

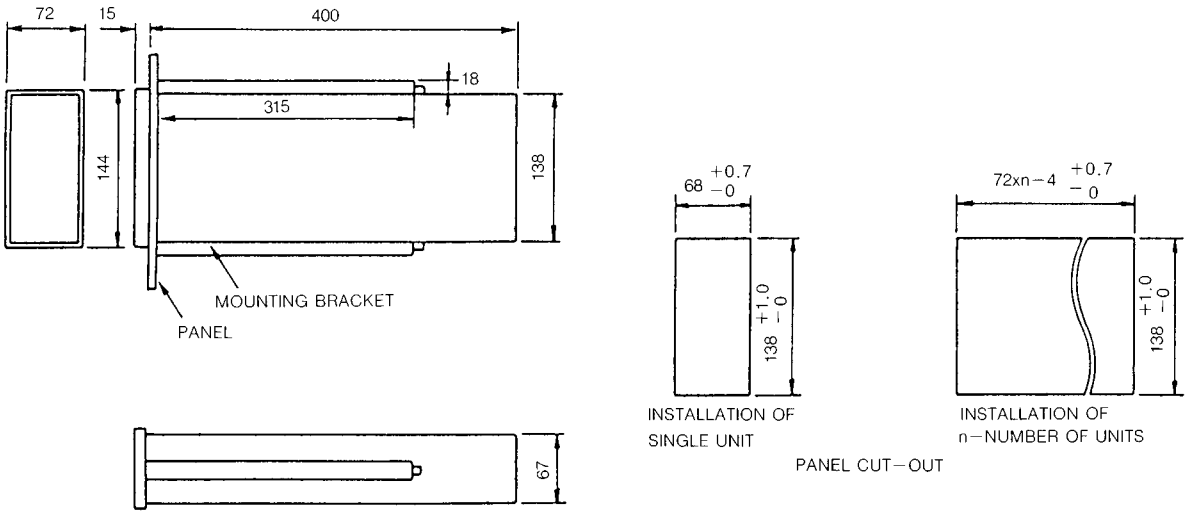
Note) Non-SI units (kgf/cm², etc.) and SI units (Pa: Pascal) are selectable in the pressure compensation.

Connection

1	2	23	24
3	4	25	26
5	6	27	28
7	8	29	30
9	10	31	32
11	12	33	34
13	14	35	36
15	16	37	38
17	18	39	40
19	20	41	42
21	22	43	44

No.	Symbol	Contents	No.	Symbol	Contents
1	+24V	Instrument main power ⊕	23	AIR1+	1−5V dc input ⊕
2	SM+24V	Standby manual power ⊕	24	AIR1−	1−5V dc input ⊖
3	AO1+	4−20mA dc output ⊕	25	AIR2+	1−5V dc input ⊕
4	AO1−	4−20mA dc output ⊖	26	AIR2−	1−5V dc input ⊖
5	AOV1+	1−5V dc output ⊕	27	AIR3+	1−5V dc input ⊕
6	AOV1−	1−5V dc output ⊖	28	AIR3−	1−5V dc input ⊖
7	AOV2+	1−5V dc output ⊕	29	AIR4+	1−5V dc input ⊕
8	AOV2−	1−5V dc output ⊖	30	AIR4−	1−5V dc input ⊖
9	AOV3+	1−5V dc output ⊕	31	AIR5+	1−5V dc input ⊕
10	AOV3−	1−5V dc output ⊖	32	AIR5−	1−5V dc input ⊖
11	OV	For Power, DO1 to 5, and S common	33	AIR6+	1−5V dc input ⊕
12	OV		34	AIR6−	1−5V dc input ⊖
13	DO1	Digital output #1	35	OV	For DI1 to 5, and interlock common
14	DO2	Digital output #2	36	OV	
15	DO3	Digital output #3	37	DI1	Digital input #1
16	DO4	Digital output #4	38	DI2	Digital input #2
17	DO5	Digital output #5	39	DI3	Digital input #3
18	S	Standby mode output	40	DI4	Digital input #4
19	SMPV+	For standby unit, PV ⊕	41	DI5	Digital input #5
20	SMPV−	For standby unit, PV ⊖	42	INT'K	External interlock signal input
21	GND	Chassis ground	43	LINK+	S-link ⊕
22	GND	Chassis ground	44	LINK−	S-link ⊖

Dimensions



Ordering Information

When ordering, please specify :

1) Model No.
2) Scale range
3) Tag No.

Specifications are subject to change without notice.

YAMATAKE

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