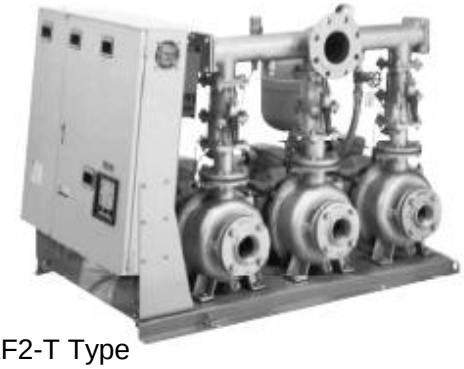
Inverter: ● Estimated Constant Terminal Pressure●
Stainless: ● VSD Control Water Supply Unit

NEW

PUMPER KF SERIES

TECHNICAL HANDBOOK FOR VSD BOOSTER PUMP

[Published 2016]



KF2-T Type
3-unit control rotary operation

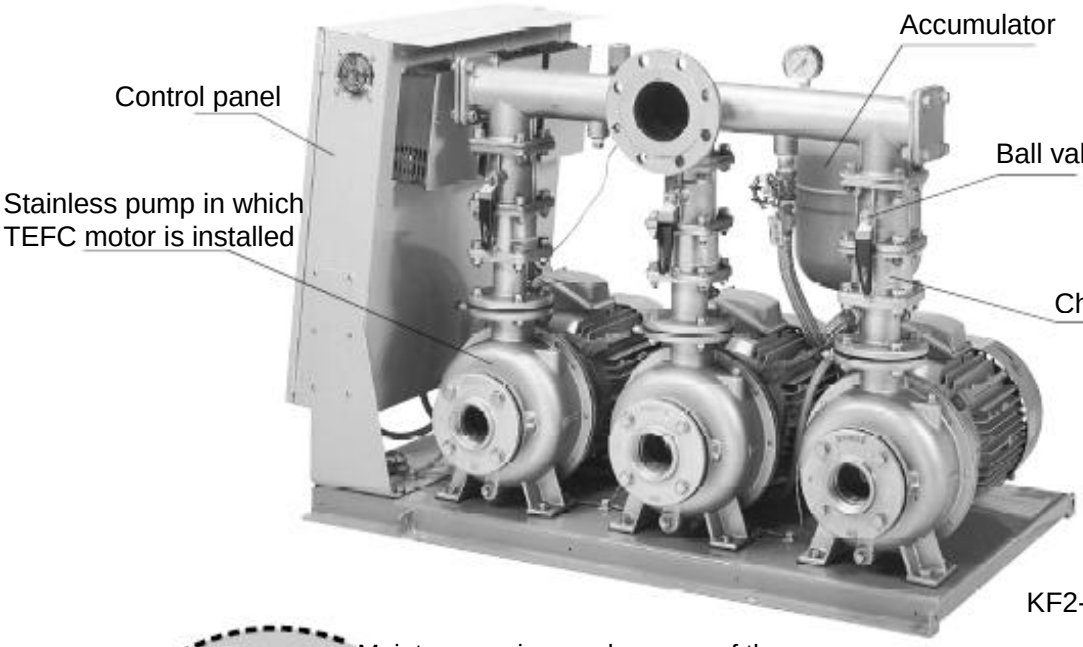
KF2-A/P Type
Alternate/Alternate &
Parallel operation

KF2-R Type multiple unit rotary
Max. Six units

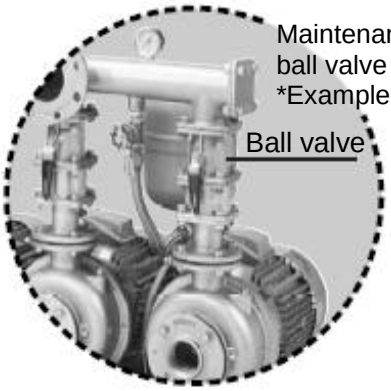
- Energy-saving of 40%
- Stainless precision casting
- Silent operation
- Adoption of total enclosed fan cool motor
- Standard installation of heater terminal block with a DC reactor
- Cumulative operation time /number of times of starting display function

KAWAMOTO PUMP ASIA CO.,LTD.

1. Features/Specifications of the Pumper KF Series
High quality water supply which is Energy saving/Silent/Clean/Constant estimated terminal pressure
Compact 3-unit rotary control



KF2-T Type



Constant estimated terminal pressure
Energy saving of 40%
The energy-saving operation (Max. 40%) because the pump's revolutions are controlled optimally depending on the change of water consumption by the inverter and the pressure change at the terminal is less because of the estimated terminal pressure constant water supply.
(Comparison between KF2 Type and our conventional model KNV)
(Comparison between KF2-R Type and our conventional model KNV-R)

High power factor/Measure against high-frequency
Basic electricity charges decrease by 5% and the generation of high-frequency is suppressed because of the high-frequency device *1 for which a DC reactor is installed in each pump. *2, and the measure against noise is perfect because of the noise filter common for surge killer/main circuit/control circuit.
(A high efficiency noise filter is adopted for the KF2-R Type)
*1: The power factor is 85% of higher.
*2: Complies with the high-frequency suppression measure implementation procedure of "General Inverter (input electrical current of 20A or less)" provided by JEMA.

Multifunction control panel
Stable water supply for a long time is promised because of the inverter for each pump, earth leakage breaker (with AL), digital voltage/electrical current operation frequency display, and the maintenance functions such as the cumulative operation time, cumulative number of times of starting display, alarm buzzer, and emergency operation function etc., and the inflow electric valve circuit *1 is installed.
*1: Excluding KF2 Type 0.75kW or lower

Secure backup function
Water failure is avoided as much as possible because of the automatic backup function for the pump's failure and inverter's failure and pressure transmitter failure and control board failure.
*KF2-R Type
An "Emergency operation switch" is installed and a water failure at the time of control panel failure is avoided.
*KF2-A/P (1.1-3.7kW)
*KF2-T (1.5-7.5kW)

Alternate & Parallel type

KF2-A/P Type

Multiple unit rotary control (Max. 6 units)

KF2-R Type

Stainless precision casting

Stainless precision casting is adopted for the pump casing and flange etc., and there is no worry about deformation. As for the materials of wet sections, mainly stainless and resin/bronze parts are adopted, so there is no worry about Rusty water. It also meets leaching properties standard.

Adoption of a low-noise TEFC motor

A low-noise TEFC motor is installed on all models as standard. Strong against insulation/degradation by dust/moisture absorption to ensure a long life.

High responsiveness/High water lifting characteristic

A new control method with a fast response to pressure fluctuation is adopted.
This ensures a silent, powerful, and smooth water supply together with excellent pump characteristics due to the high efficiency 3D impeller.

Improved workability/Small and light

A compact and light unit of 520mm or smaller can be installed under the water tank. (KF2-A/P 3.7kW unit or lower).
The suction/discharge flange surfaces are on the same surface, and the discharge piping is at the unit's centre. The KF2-R Type is smaller by a maximum of 45% compared to the conventional model (SKF3 Type). It is possible to select either a left or right discharging direction.

With heater terminal

A heater terminal is installed as standard. It is easy to install the heater.

Integrated specification for all over Japan

For both the 50Hz and 60Hz units.
These models have a common positive suction and suction system.

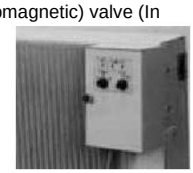
■Standard specification

Control method	Constant pressure at estimated terminal outlet using frequency control. (Constant discharge pressure is possible)
Operation method	Alternate/Alternate & Parallel/Multiple rotary units (Max. 6 units)
Installation location	Indoor (Ambient temperature: 0-40℃, Humidity: 90% or lower, Altitude 1,000m or lower)
Liquid lifting	clean, 0-40℃
Pump(Material)	Stainless multistage turbine pump (Impeller: Resin, CAC406 (BC6) or SCS13) (Main axis: Wet section SUS304, Casing: SCS13)
Motor	TEFC indoor type: 3.7kW or lower, TEFC outdoor type: 5.5kW or over
	Number of poles: 2 poles (Automatic operation with maximum frequency: 60Hz)
Suction condition	Positive suction <0-5m (*1)> or negative suction <Within suction total head -6m (*2)>
Power source	3PH380V or 1PH220V
Companion flange shape	JIS10K thin type (None at the discharge side of KF2-T/KF2-R)
Paint colour (Munsell No.)	Control panel: Grey (5Y7/1), Accumulator: Grey (10Y5.5/0.5), Others: Grey (2.5PB5.1/0.8)

(*1) 3m for 40-5.5kW/50-7.5kW. Consult Kawamoto pump if the head exceeds 5m.
(*2) Positive suction actual head: Within -4m, Suction total head of 0.4kW: Within -4m.
(It is recommended to install relief piping always for the suction specification. Consult us for the details.)

Note: In the case of using a flush valve or a small water volume for a long time, consult with us separately.

■Special specification
●BL certified product <Note 1>
●400V specification (1.5kW or higher of KF2 Type Alternate/Alternate & parallel)
(KF2-T 1.5kW or higher)
(KF2-R 2.2kW or higher)
●KF2 Type: Built-in sluice valve (Excluding the suction port diameter of 65mm only for the BL certified product)
●Impeller: CAC (BC) (Excluding the suction port diameter of 32mm, 65mm and 5.5kW or higher)
●Circuit for the positive suction electro (electromagnetic) valve (In control box: KF2 Type for 0.75kW or lower)
●With heater
●Control panel position change
(Excluding KF2 Type an KF2-T Type up to 3,7kW and suction port diameter of 65mm)
●Operation by reducing the number of units (Excluding A/P)
●With vibration proof function (KF2 Type)
●With emergency stop function (KF2-R Type)



Inflow electromagnetic valve circuit

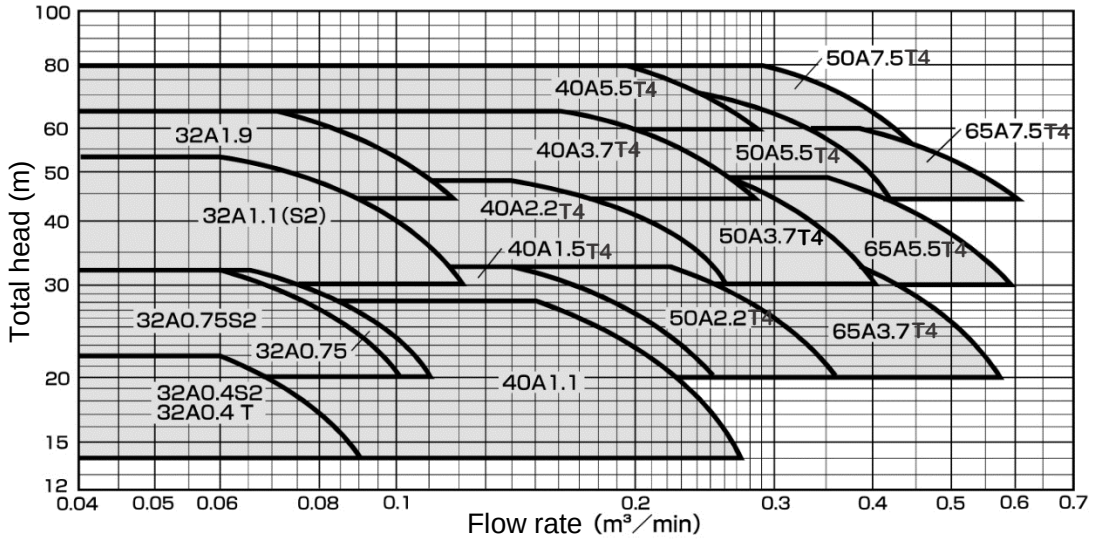
■Special accessory
●Pump cover: For KF2 Type (Steel plate/Stainless)
●Heater ●Foot valve (In case of for suction)
●Level relay (For KF2 Type 0.75kW or lower water reducing)
●Discharge direction change connection tube (For KF2 Type)
●Vibration proof stage (KF2 Type)
●Electrode bar
●Foundation bolt

Discharge direction change connection tube

<Note 1> Be careful of the installation location.
In the case of using at a location other than the standard installation location (applicable range) of B/L, the performance as a B/L certified product might not be shown, and it shall not be judged as a B/L certified product.
<Note 2> Excluding 400V specification 5.5kW or higher or product with a changed position of the control panel.

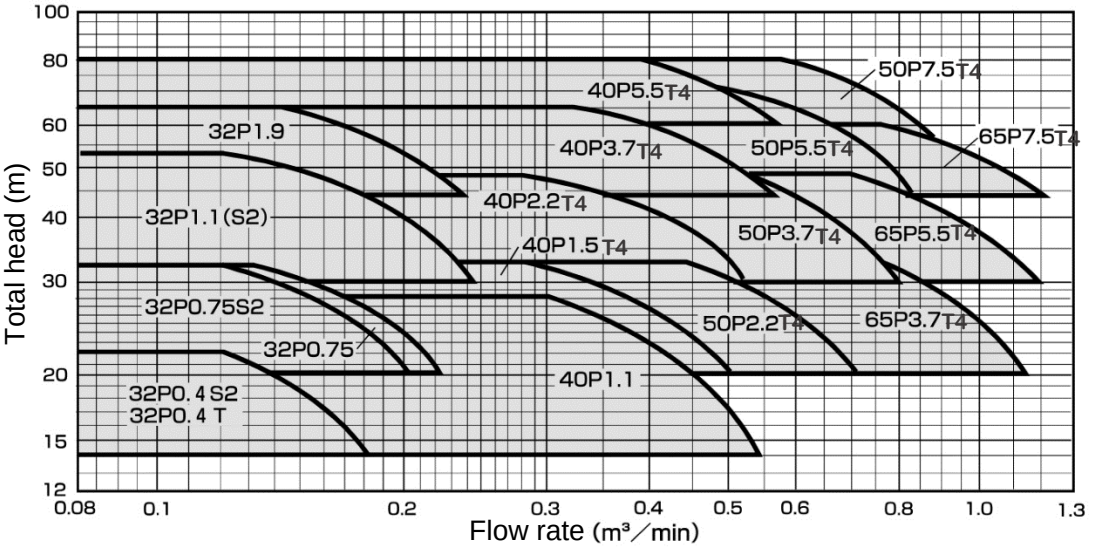
2. Selection change/Specification table

KF2 Type selection change, Operation of 2 pumps (Alternate)



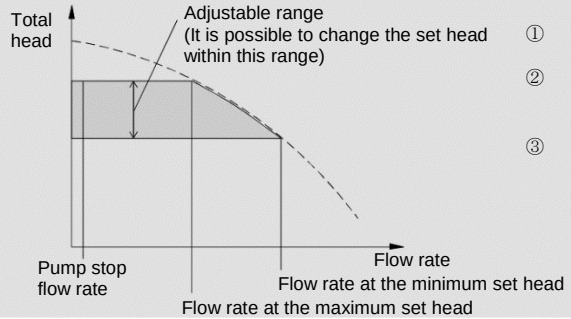
The specification values are after subtracting the losses in the unit such as the check valve etc.

Operation of 2 pumps (Alternate & Parallel)



The specification values are after subtracting the losses in the unit such as the check valve etc.

How to check the application drawing/specification table



① The total head is shown as the value after subtracting the losses of the check valve (shock-less valve) etc. from the pump's performance.

② In the case of changing the set head, use within the set head adjustable range. The starting pressure is set as the estimated terminal pressure of -0.04MPa (0.4kgf/c㎡) automatically,

③ Use with the suction condition within the range of positive suction 5m/suction total head-6m. The maximum flow rate depending on the set head varies depending on the suction conditions.

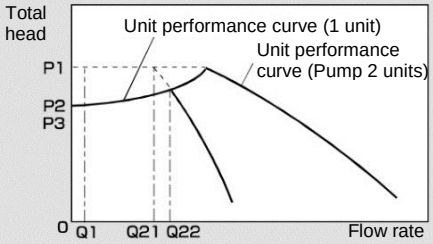
■Specification Table (Pump stop flow rate: 10L/min)

Unit bore	Suction bore	Operation method	Model	Motor	Standard specification				Set head adjustable range	Accumulator charged pressure	Noise (*1)	Power factor
					Flow rate	Total head	Set head	Starting pressure				
mm	mm			kW	M^3/min	m	m	MPa {kgf/cm^2}	m	MPa {kgf/cm^2}	dB[A]	(%)
40	32	Alternate	KF2-32A0.4S2	0.4 *	0.06	22	22	0.16{1.6}	14~22	0.069{0.7}	41~43	-
			KF2-32A0.4T	0.4	0.06	22	22	0.16{1.6}	14~22	0.069{0.7}	41~43	86.8
			KF2-32A0.75S2	0.75 *	0.06	32	32	0.25{2.5}	20~32	0.12{1.2}	47~50	-
			KF2-32A0.75	0.75	0.065	32	32	0.25{2.5}	20~32	0.12{1.2}	46~50	90.0
			KF2-32A1.1S2	1.1 *	0.06	53	53	0.43{4.4}	30~53	0.22{2.2}	48~51	-
			KF2-32A1.1	1.1	0.06	53	53	0.43{4.4}	30~53	0.22{2.2}	48~51	87.5
			KF2-32A1.9	1.9	0.07	65	65	0.54{5.5}	44~65	0.31{3.2}	48~55	85.5
	40		KF2-40A1.1	1.1	0.145	28	28	0.21{2.1}	14~28	0.069{0.7}	48~50	87.5
			KF2-40A1.5T4	1.5	0.14	32	32	0.25{2.5}	20~32	0.12{1.2}	49~52	89.6
			KF2-40A2.2T4	2.2	0.14	48	48	0.38{3.9}	30~48	0.20{2.0}	49~52	89.2
			KF2-40A3.7T4	3.7	0.16	65	65	0.54{5.5}	44~65	0.31{3.2}	55~56	88.7
			KF2-40A5.5T4	5.5	0.19	80	80	0.67{6.8}	60~80	0.44{4.5}	55~59	87.9
	50		KF2-50A2.2T4	2.2	0.225	32	32	0.25{2.5}	20~32	0.12{1.2}	52~54	89.2
			KF2-50A3.7T4	3.7	0.265	48	48	0.38{3.9}	30~48	0.20{2.0}	54~55	88.7
			KF2-50A5.5T4	5.5	0.24	70	70	0.58{5.9}	44~70	0.34{3.5}	58~60	87.9
			KF2-50A7.5T4	7.5	0.28	80	80	0.67{6.8}	56~80	0.44{4.5}	58~63	90.4
50	65		KF2-65A3.7T4	3.7	0.38	32	32	0.25{2.5}	20~32	0.12{1.2}	54~56	88.7
			KF2-65A5.5T4	5.5	0.35	48	48	0.38{3.9}	30~48	0.20{2.0}	58~60	87.9
			KF2-65A7.5T4	7.5	0.38	60	60	0.49{5.0}	44~60	0.31{3.2}	58~62	90.4

Unit bore	Suction bore	Operation method	Model	Motor	Standard specification				Set head adjustable range	Accumulator charged pressure	Noise (*1)	Power factor
					Flow rate	Total head	Set head	Starting pressure				
mm	mm			kW	M^3/min	m	m	MPa {kgf/cm^2}	m	MPa {kgf/cm^2}	dB[A]	(%)
40	32	Alternate/Parallel	KF2-32P0.4S2	0.4×2 *	0.12	22	22	0.16{1.6}	14~22	0.069{0.7}	41~46	-
			KF2-32P0.4T	0.4×2	0.12	22	22	0.16{1.6}	14~22	0.069{0.7}	41~46	90.3
			KF2-32P0.75S2	0.75×2*	0.12	32	32	0.25{2.5}	20~32	0.12{1.2}	47~53	-
			KF2-32P0.75	0.75×2	0.13	32	32	0.25{2.5}	20~32	0.12{1.2}	46~53	90.7
			KF2-32P1.1S2	1.1×2 *	0.12	53	53	0.43{4.4}	30~53	0.22{2.2}	48~54	-
			KF2-32P1.1	1.1×2	0.12	53	53	0.43{4.4}	30~53	0.22{2.2}	48~54	91.5
			KF2-32P1.9	1.9×2	0.14	65	65	0.54{5.5}	44~65	0.31{3.2}	48~58	89.9
	40		KF2-40P1.1	1.1×2	0.29	28	28	0.21{2.1}	14~28	0.069{0.7}	48~53	91.5
			KF2-40P1.5T4	1.5×2	0.28	32	32	0.25{2.5}	20~32	0.12{1.2}	49~55	92.5
			KF2-40P2.2T4	2.2×2	0.28	48	48	0.38{3.9}	30~48	0.20{2.0}	49~55	91.6
			KF2-40P3.7T4	3.7×2	0.32	65	65	0.54{5.5}	44~65	0.31{3.2}	55~59	90.3
			KF2-40P5.5T4	5.5×2	0.38	80	80	0.67{6.8}	60~80	0.44{4.5}	55~62	91.4
	50		KF2-50P2.2T4	2.2×2	0.45	32	32	0.25{2.5}	20~32	0.12{1.2}	52~57	91.6
			KF2-50P3.7T4	3.7×2	0.53	48	48	0.38{3.9}	30~48	0.20{2.0}	54~58	90.3
			KF2-50P5.5T4	5.5×2	0.48	70	70	0.58{5.9}	44~70	0.34{3.5}	58~63	91.4
			KF2-50P7.5T4	7.5×2	0.56	80	80	0.67{6.8}	56~80	0.44{4.5}	58~66	92.7
50	65		KF2-65P3.7T4	3.7×2	0.76	32	32	0.25{2.5}	20~32	0.12{1.2}	54~59	90.3
			KF2-65P5.5T4	5.5×2	0.70	48	48	0.38{3.9}	30~48	0.20{2.0}	58~63	91.4
			KF2-65P7.5T4	7.5×2	0.76	60	60	0.49{5.0}	44~60	0.31{3.2}	58~65	92.7

(Note) ●Consult us separately in the case of using a large volume of water instantly such as a flush valve etc. (*) For single phase 200V (*1) the noise value is the value from the discharge volume at zero to the standard specification point (reference value)

Explanation on operation

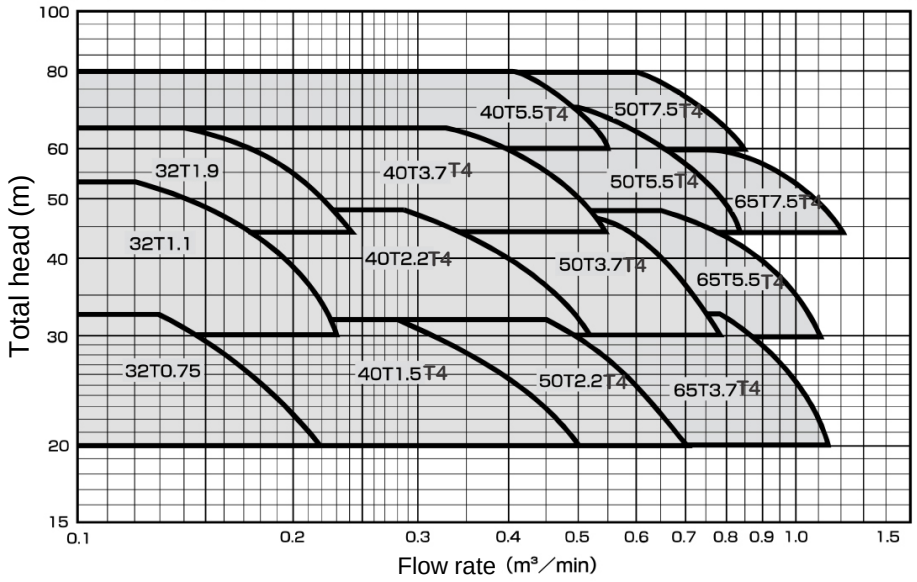


P1: Set head
P2: Estimated terminal head
P3: Starting head (P2-0.04MPa {0.4kgf/cm^2}
Q1: Stop flow rate (10L/min) Q21-Q22: Parallel off/parallel on flow rate
*Breaking line means constant operation of discharge volume pressure

■Alternate operation
① If water is used while the pump is not operating and the pressure decreases to P3, the pump starts operating.
② In the case that the water consumption is Q1 or higher, the pump keeps the water supply at the constant estimated terminal pressure.
③ If the water consumption decreases and becomes Q1 or lower, the pump stops.
④ Pump 1 and Pump 2 repeat ①–③ alternately.

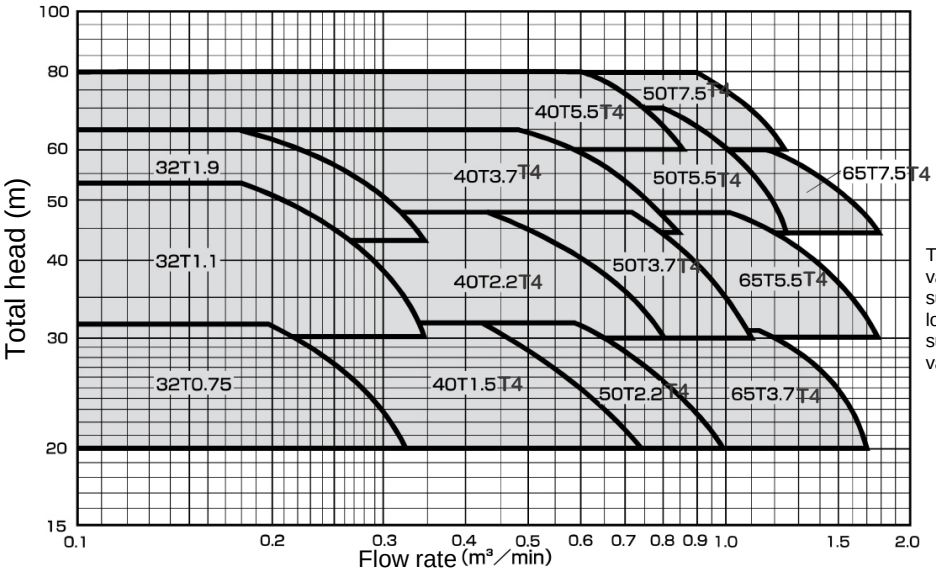
■Alternate & Parallel operation
① If the water consumption increases to Q22 or higher during a single pump operation, the second pump starts by detecting the pressure, and the parallel operation starts.
② If water consumption decreases to Q21 or lower during parallel operation status, the first pump stops by detecting the pressure, and single operation starts.
③ In the case that water consumption is less than Q21, the Alternate operation is implemented.

KF2-T Type selection charge, Operation of 2 pump (2/3 pumps rotary)



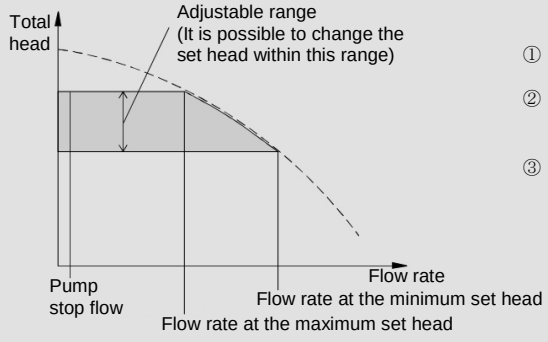
The specification values are after subtracting the losses in the unit such as the check valve etc.

KF2-T Type selection charge, Operation of 3 pump (3/3 pumps rotary)



The specification values are after subtracting the losses in the unit such as the check valve etc.

How to check the application drawing/specification table



① The total head is shown as the value after subtracting the losses of check valve (shock-less valve) etc. from the pump performance.

② In case of changing the setting head, use within the setting head adjustable range. The starting pressure is set as the estimated terminal pressure of -0.04MPah(0.4kgf/c m^2) automatically,

③ Use with the suction condition within the range of positive suction 5m/suction total head-6m. The maximum discharging volume depending on the setting head varies depending on suction conditions.

■Specification Table (Pump stop flow rate: 10L/min)

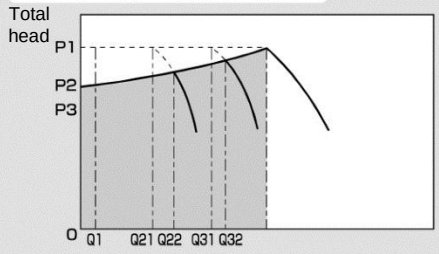
Unit bore	Suction bore	Operation method	Model	Motor	Standard specification				Set head adjustable range	Accumulator charged pressure	Noise (*1)	Power factor
					Flow rate	Total head	Set head	Starting pressure				
mm	mm			kW	M^3/min	m	m	MPa {kgf/cm^2}	m	MPa {kgf/cm^2}	dB[A]	(%)
50	32	2/3 pump rotary	KF2-32T0.75	0.75×2	0.13	32	32	0.25{2.5}	20~32	0.12{1.2}	46~53	90.7
			KF2-32T1.1	1.1×2	0.12	53	53	0.43{4.4}	30~53	0.22{2.2}	48~54	91.5
			KF2-32T1.9	1.9×2	0.14	65	65	0.54{5.5}	44~65	0.31{3.2}	48~58	89.9
80	40		KF2-40T1.5T4	1.5×2	0.28	32	32	0.25{2.5}	20~32	0.12{1.2}	49~55	92.5
			KF2-40T2.2T4	2.2×2	0.28	48	48	0.38{3.9}	30~48	0.20{2.0}	49~55	91.6
			KF2-40T3.7T4	3.7×2	0.32	65	65	0.54{5.5}	44~65	0.31{3.2}	55~59	90.3
			KF2-40T5.5T4	5.5×2	0.41	80	80	0.67{6.8}	60~80	0.44{4.5}	55~62	91.4
	50		KF2-50T2.2T4	2.2×2	0.45	32	32	0.25{2.5}	20~32	0.12{1.2}	52~57	91.6
			KF2-50T3.7T4	3.7×2	0.53	48	48	0.38{3.9}	30~48	0.20{2.0}	54~58	90.3
			KF2-50T5.5T4	5.5×2	0.5	70	70	0.58{5.9}	44~70	0.34{3.5}	58~63	91.4
			KF2-50T7.5T4	7.5×2	0.6	80	80	0.67{6.8}	60~80	0.44{4.5}	58~66	92.7
100	65		KF2-65T3.7T4	3.7×2	0.76	32	32	0.25{2.5}	20~32	0.12{1.2}	54~59	90.3
			KF2-65T5.5T4	5.5×2	0.66	48	48	0.38{3.9}	30~48	0.20{2.0}	58~63	91.4
			KF2-65T7.5T4	7.5×2	0.76	60	60	0.49{5.0}	44~60	0.31{3.2}	58~65	92.7

(Note) ●Consult us separately in the case of using a large volume of water instantly such as a flush valve etc. (*1) the noise value is the value from the discharge volume at zero to the standard specification point (reference value)

Unit bore	Suction bore	Operation method	Model	Motor	Standard specification				Set head adjustable range	Accumulator charged pressure	Noise (*1)	Power factor
					Flow rate	Total head	Set head	Starting pressure				
mm	mm			kW	M^3/min	m	m	MPa {kgf/cm^2}	m	MPa {kgf/cm^2}	dB[A]	(%)
50	32	3/3 pump rotary	KF2-32T0.75G	0.75×3	0.195	32	32	0.25{2.5}	20~32	0.12{1.2}	46~57	91.3
			KF2-32T1.1G	1.1×3	0.18	53	53	0.43{4.4}	30~53	0.22{2.2}	48~59	92.8
			KF2-32T1.9G	1.9×3	0.18	65	65	0.54{5.5}	44~65	0.31{3.2}	48~59	91.0
80	40		KF2-40T1.5T4	1.5×3	0.42	32	32	0.25{2.5}	20~32	0.12{1.2}	49~59	93.2
			KF2-40T2.2T4	2.2×3	0.42	48	48	0.38{3.9}	30~48	0.20{2.0}	49~59	89.1
			KF2-40T3.7T4	3.7×3	0.48	65	65	0.54{5.5}	44~65	0.31{3.2}	55~63	91.7
			KF2-40T5.5T4	5.5×3	0.6	80	80	0.67{6.8}	60~80	0.44{4.5}	55~66	92.5
	50		KF2-50T2.2T4	2.2×3	0.59	32	32	0.25{2.5}	20~32	0.12{1.2}	52~61	89.1
			KF2-50T3.7T4	3.7×3	0.7	48	48	0.38{3.9}	30~48	0.20{2.0}	54~63	91.7
			KF2-50T5.5T4	5.5×3	0.78	70	70	0.58{5.9}	44~70	0.34{3.5}	58~66	92.5
			KF2-50T7.5T4	7.5×3	0.9	80	80	0.67{6.8}	60~80	0.44{4.5}	58~67	93.3
100	65		KF2-65T3.7T4	3.7×3	1.12	32	32	0.25{2.5}	20~32	0.12{1.2}	54~63	91.7
			KF2-65T5.5T4	5.5×3	1.0	48	48	0.38{3.9}	30~48	0.20{2.0}	58~65	92.5
			KF2-65T7.5T4	7.5×3	1.14	60	60	0.49{5.0}	44~60	0.31{3.2}	58~67	93.3

(Note) ●Consult us separately in the case of using a large volume of water instantly such as a flush valve etc. (*1) the noise value is the value from the discharge volume at zero to the standard specification point (reference value)

Explanation of operation <Example of 3 rotary units >

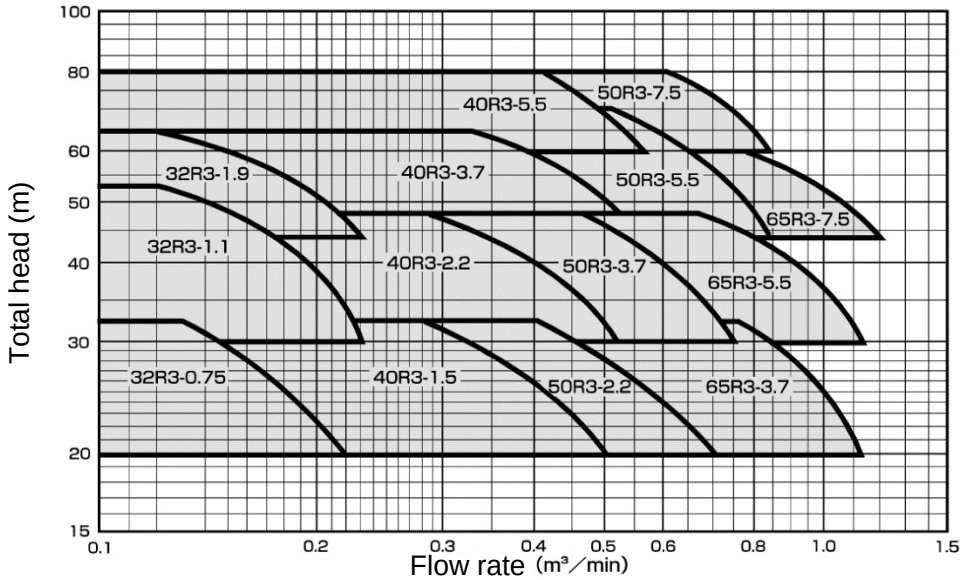


P1: Set head
P2: Estimated terminal head
P3: Starting pressure
(P2-0.04MPa {0.4kg/cm^2})

Q1: Stop flow (10L/min)
Q21/Q22: Flow increase/decrease of second pump
Q31/Q32: Flow increase/decrease of third pump
The broken line is for the constant discharge operation.

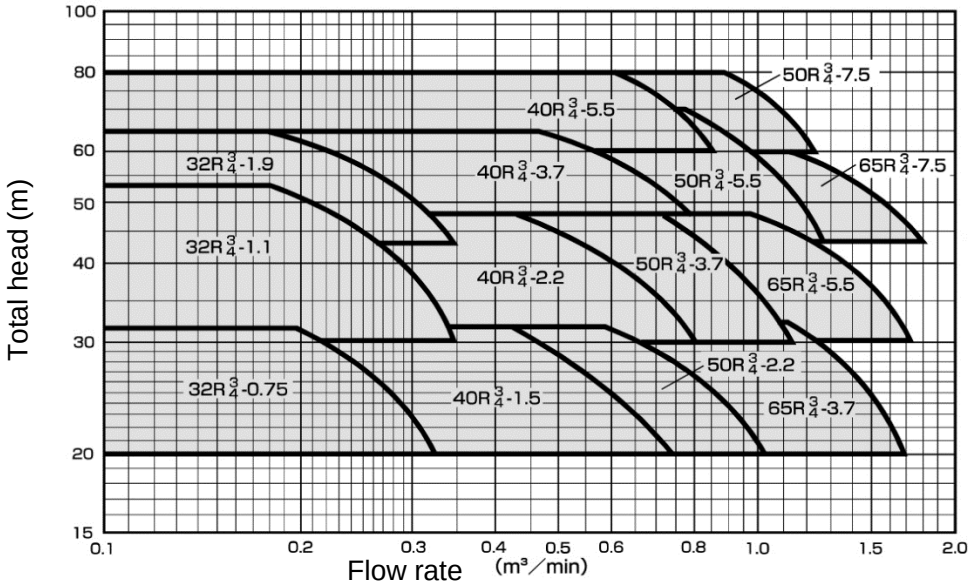
① If water is used while the pump is not operating and the pressure decreases to P3, the pump starts operating.
② If water consumption is between Q1 and Q21, the water supply continues at the constant estimated terminal pressure.
③ If water consumption decreases to less than Q1, the pump stops.
④ If water consumption is lower than Q21, the alternative operation is repeated.
⑤ If water consumption increases to Q22 or higher during the single operation, the second pump starts and the 2-unit operation starts. If water consumption increases above Q32, the third pump starts operating and the 3-unit operation starts.
⑥ If water consumption becomes Q31 or lower during the 3-unit operation, the number of pump units reduces by detecting the pressure, and 2-unit operation starts. If water consumption decreases to Q21 or lower, the number of pump units reduces, and the single operation starts.
⑦ If water consumption is Q1 or lower, the pump stops.

KF2-R Type selection charge, Operation of 2 pump (2/3 pump rotary)



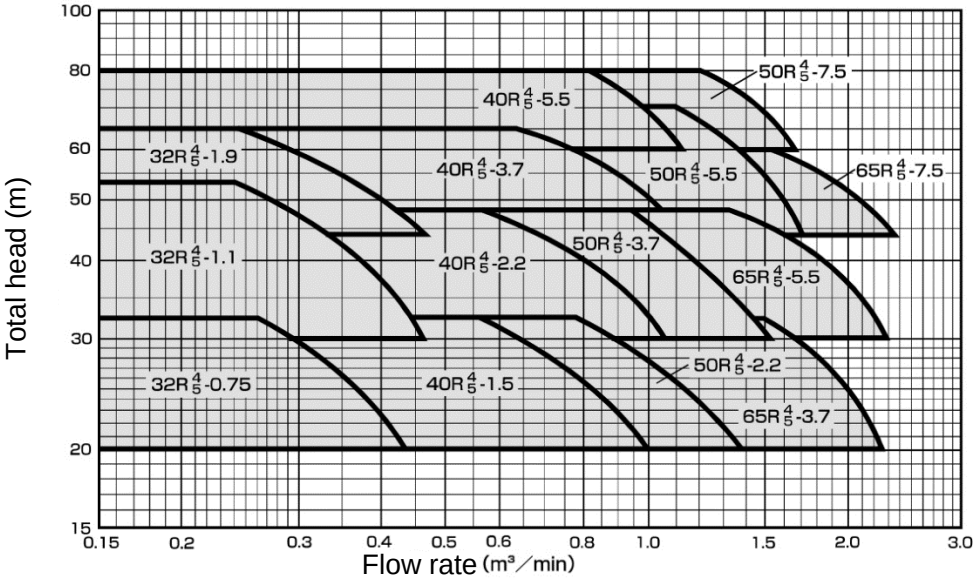
The specification values are after subtracting the losses in the unit such as the check valve etc.

Operation of 3 pump (3/4 pump rotary)



The specification values are after subtracting the losses in the unit such as the check valve etc.

Operation of 4 pump (4/5 pump rotary)



The specification values are after subtracting the losses in the unit such as the check valve etc.

■Specification Table (Small water volume stop: 10L/min)

Unit bore	Suction bore	Operation method	Model	Motor	Standard specification				Set head adjustable range	Accumulator charged pressure	Noise (*1)	Power factor
					Flow rate	Total head	Set head	Starting pressure				
mm	mm			kW	M^3/min	m	m	MPa {kgf/cm^2}	m	MPa {kgf/cm^2}	dB[A]	(%)
65	32	2/3 pump rotary	KF2-32R3E0.75	0.75×2	0.13	32	32	0.25{2.5}	20~32	0.19{1.9}	53	90.7
			KF2-32R3E1.1	1.1×2	0.12	53	53	0.43{4.4}	30~53	0.33{3.4}	54	91.5
			KF2-32R3E1.9	1.9×2	0.14	65	65	0.54{5.5}	44~65	0.42{4.3}	58	89.9
80	40		KF2-40R3E1.5	1.5×2	0.28	32	32	0.25{2.5}	20~32	0.19{1.9}	55	92.5
			KF2-40R3E2.5	2.2×2	0.28	48	48	0.38{3.9}	30~48	0.29{3.0}	55	91.6
			KF2-40R3E3.7	3.7×2	0.32	65	65	0.54{5.5}	44~65	0.42{4.3}	59	90.3
			KF2-40R3E5.5	5.5×2	0.41	80	80	0.67{6.8}	60~80	0.58{5.9}	62	91.4
100	50		KF2-50R3E2.5	2.2×2	0.45	32	32	0.25{2.5}	20~32	0.19{1.9}	57	91.6
			KF2-50R3E3.7	3.7×2	0.53	48	48	0.38{3.9}	30~48	0.29{3.0}	58	90.3
			KF2-50R3E5.5	5.5×2	0.5	70	70	0.58{5.9}	44~70	0.50{5.1}	63	91.4
			KF2-50R3E7.5	7.5×2	0.6	80	80	0.67{6.8}	60~80	0.58{5.9}	66	92.7
125	65		KF2-65R3E3.7	3.7×2	0.76	32	32	0.25{2.5}	20~32	0.19{1.9}	59	90.3
			KF2-65R3E5.5	5.5×2	0.66	48	48	0.38{3.9}	30~48	0.32{3.3}	63	91.4
			KF2-65R3E7.5	7.5×2	0.76	60	60	0.49{5.0}	44~60	0.42{4.3}	65	92.7

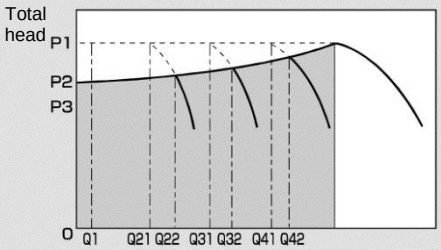
Unit bore	Suction bore	Operation method	Model	Motor	Standard specification				Set head adjustable range	Accumulator charged pressure	Noise (*1)	Power factor
					Flow rate	Total head	Set head	Starting pressure				
mm	mm			kW	M^3/min	m	m	MPa {kgf/cm^2}	m	MPa {kgf/cm^2}	dB[A]	(%)
65	32	3/3, 3/4 pump rotary	KF2-32R3(4)E0.75	0.75×3	0.195	32	32	0.25{2.5}	20~32	0.19{1.9}	57	91.3
			KF2-32R3(4)E1.1	1.1×3	0.18	53	53	0.43{4.4}	30~53	0.33{3.4}	59	92.8
			KF2-32R3(4)E1.9	1.9×3	0.18	65	65	0.54{5.5}	44~65	0.42{4.3}	59	91.0
80	40		KF2-40R3(4)E1.5	1.5×3	0.42	32	32	0.25{2.5}	20~32	0.19{1.9}	59	93.2
			KF2-40R3(4)E2.5	2.2×3	0.42	48	48	0.38{3.9}	30~48	0.29{3.0}	59	89.1
			KF2-40R3(4)E3.7	3.7×3	0.48	65	65	0.54{5.5}	44~65	0.42{4.3}	63	91.7
			KF2-40R3(4)E5.5	5.5×3	0.6	80	80	0.67{6.8}	60~80	0.58{5.9}	66	92.5
100	50		KF2-50R3(4)E2.5	2.2×3	0.59	32	32	0.25{2.5}	20~32	0.19{1.9}	61	89.1
			KF2-50R3(4)E3.7	3.7×3	0.7	48	48	0.38{3.9}	30~48	0.29{3.0}	63	91.7
			KF2-50R3(4)E5.5	5.5×3	0.78	70	70	0.58{5.9}	44~70	0.50{5.1}	66	92.5
			KF2-50R3(4)E7.5	7.5×3	0.9	80	80	0.67{6.8}	60~80	0.58{5.9}	67	93.3
125	65		KF2-65R3(4)E3.7	3.7×3	1.12	32	32	0.25{2.5}	20~32	0.19{1.9}	63	91.7
			KF2-65R3(4)E5.5	5.5×3	1.0	48	48	0.38{3.9}	30~48	0.32{3.3}	65	92.5
			KF2-65R3(4)E7.5	7.5×3	1.14	60	60	0.49{5.0}	44~60	0.42{4.3}	67	93.3

Unit bore	Suction bore	Operation method	Model	Motor	Standard specification				Set head adjustable range	Accumulator charged pressure	Noise (*1)	Power factor
					Flow rate	Total head	Set head	Starting pressure				
mm	mm			kW	M^3/min	m	m	MPa {kgf/cm^2}	m	MPa {kgf/cm^2}	dB[A]	(%)
65	32	4/4, 4/5 pump rotary	KF2-32R4E0.75	0.75×4	0.26	32	32	0.25{2.5}	20~32	0.19{1.9}	59	-
			KF2-32R4E1.1	1.1×4	0.24	53	53	0.43{4.4}	30~53	0.33{3.4}	61	87.8
			KF2-32R4E1.9	1.9×4	0.24	65	65	0.54{5.5}	44~65	0.42{4.3}	61	87.2
80	40		KF2-40R4E1.5	1.5×4	0.56	32	32	0.25{2.5}	20~32	0.19{1.9}	61	89.9
			KF2-40R4E2.5	2.2×4	0.56	48	48	0.38{3.9}	30~48	0.29{3.0}	61	90.3
			KF2-40R4E3.7	3.7×4	0.64	65	65	0.54{5.5}	44~65	0.42{4.3}	65	92.3
			KF2-40R4E5.5	5.5×4	0.8	80	80	0.67{6.8}	60~80	0.58{5.9}	68	93.2
100	50		KF2-50R4E2.5	2.2×4	0.79	32	32	0.25{2.5}	20~32	0.19{1.9}	63	90.3
			KF2-50R4E3.7	3.7×4	0.94	48	48	0.38{3.9}	30~48	0.29{3.0}	65	92.3
			KF2-50R4E5.5	5.5×4	1.1	70	70	0.58{5.9}	44~70	0.50{5.1}	67	93.2
			KF2-50R4E7.5	7.5×4	1.19	80	80	0.67{6.8}	60~80	0.58{5.9}	68	93.6
125	65		KF2-65R4E3.7	3.7×4	1.52	32	32	0.25{2.5}	20~32	0.19{1.9}	64	92.3
			KF2-65R4E5.5	5.5×4	1.3	48	48	0.38{3.9}	30~48	0.32{3.3}	66	93.2
			KF2-65R4E7.5	7.5×4	1.52	60	60	0.49{5.0}	44~60	0.42{4.3}	69	93.6

(Note) ●Consult us separately in the case of using a large volume of water instantly such as a flush valve etc. (*1) (Reference value)

Explanation of operation

<Example of 4 units rotary>

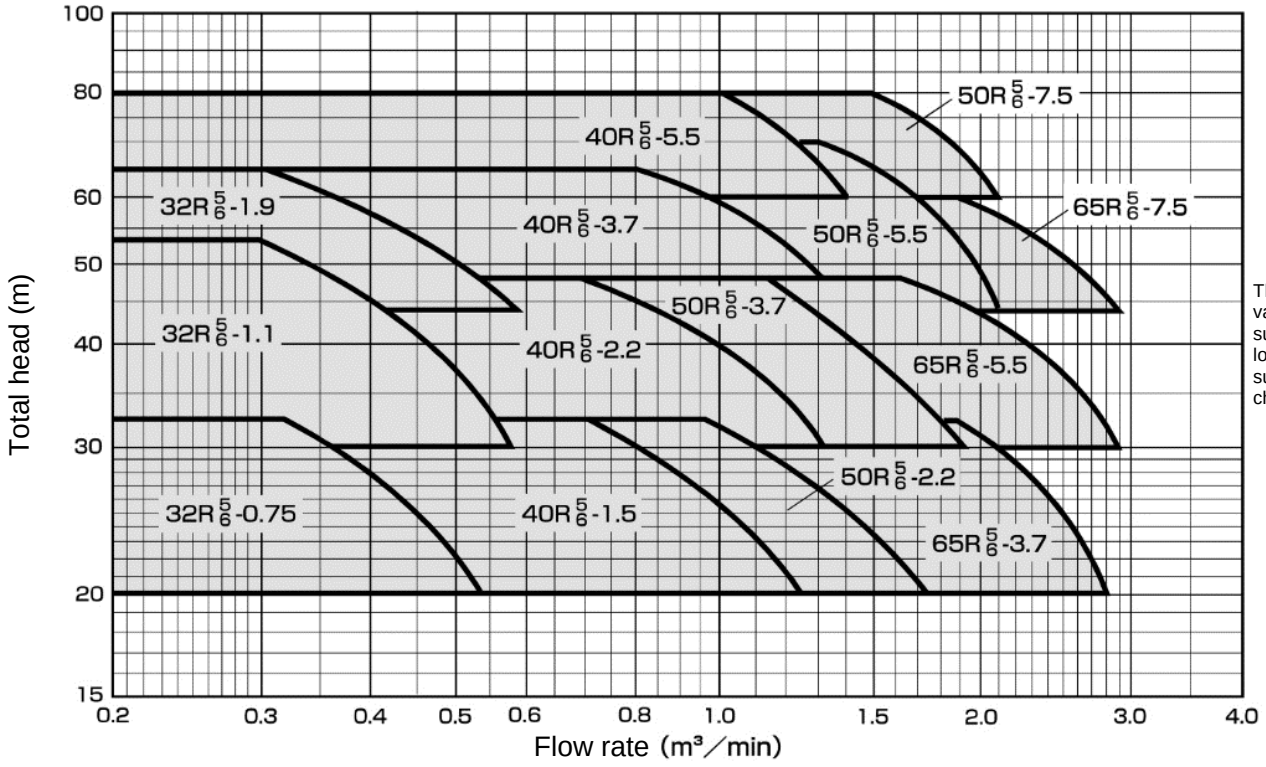


P1: Set head
P2: Estimated terminal head
P3: Starting pressure
(P2-0.04MPa {0.4kg/cm^2}

Q1: Stop flow (10L/min)
Q21/Q22: Flow increase/decrease of second pump
Q31/Q32: Flow increase/decrease of third pump
Q41/Q42: Flow increase/decrease of fourth pump
The broken line is for the constant discharge operation.

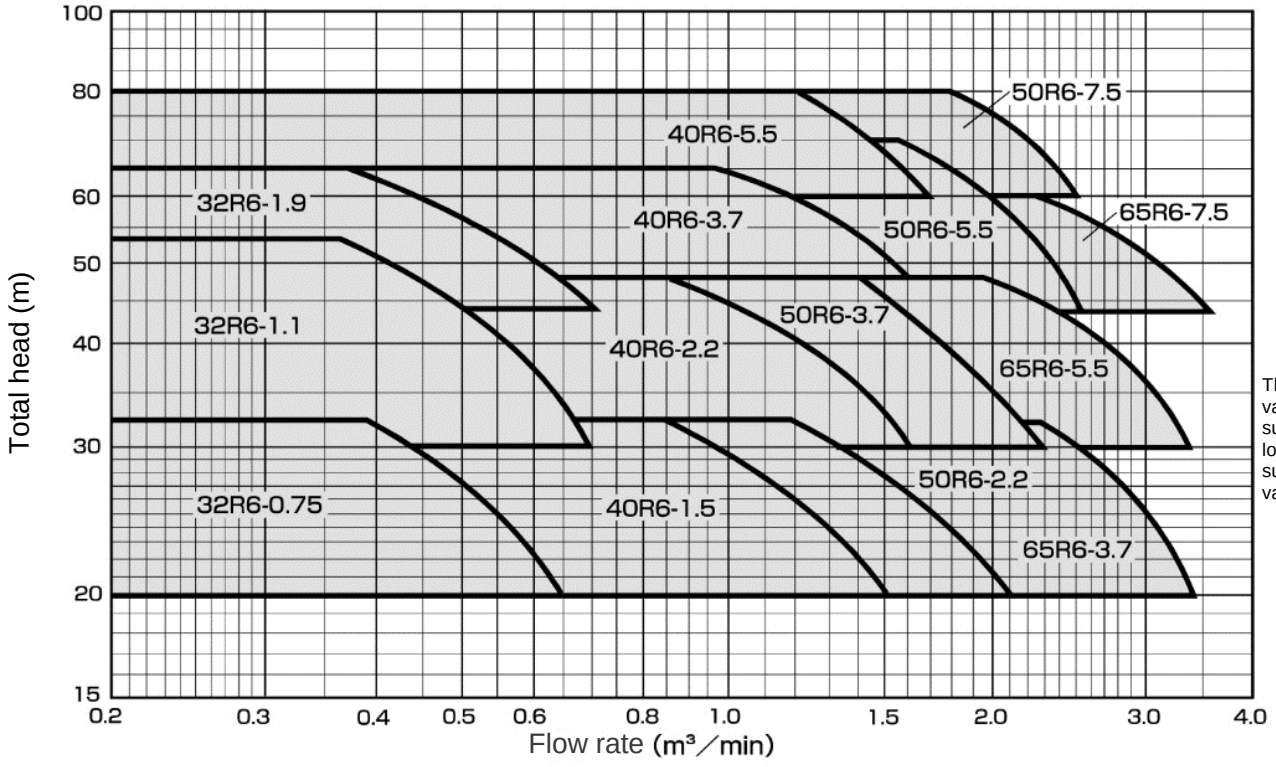
① If water is used while the pump is not operating and the pressure decreases to P3, the pump starts operating.
② If water consumption is between Q1 and Q21, the water supply continues at the constant estimated terminal pressure.
③ If water consumption decreases lower than Q1, the pump stops.
④ If water consumption is lower than Q21, the alternative operation is repeated.
⑤ If water consumption increases to Q22 or higher during the single operation, the second pump starts and the 2-unit operation starts. If water consumption increases to Q32/Q42, the third/fourth pumps start operating and the 3- or 4-unit operation starts.
⑥ If water consumption becomes Q41or lower during the 4-unit operation, the number of pump units reduces by pressure detection, and the 3 unit operation starts. If water consumption decreases to Q31/Q21 or lower, the number of pump units reduces, and the 2-unit/single operation starts.
⑦ If water consumption becomes Q1 or lower, the pump stops.

Operation of 5 pump: 5/5, 5/6 pump rotary



The specification values are after subtracting the losses in the unit such as the check valve etc.

Operation of 6 pump: 6/6 pump rotary



The specification values are after subtracting the losses in the unit such as the check valve etc.

■Specification Table (Small water quantity stopping flow: 10L/min)

Unit bore	Suction bore	Operation method	Model	Motor	Standard specification				Set head adjustable range	Accumulator charged pressure	Noise (*1)	Power factor
					Flow rate	Total head	Set head	Starting pressure				
mm	mm			kW	M^3/min	m	m	MPa {kgf/cm^2}	m	MPa {kgf/cm^2}	dB[A]	(%)
80	32	5/5, 5/6 pump rotary	KF2-32R5(6)E0.75	0.75×5	0.325	32	32	0.25{2.5}	20~32	0.19{1.9}	60	-
			KF2-32R5(6)E1.1	1.1×5	0.3	53	53	0.43{4.4}	30~53	0.33{3.4}	62	90.2
			KF2-32R5(6)E1.9	1.9×5	0.3	65	65	0.54{5.5}	44~65	0.42{4.3}	62	90.2
100	40		KF2-40R5(6)E1.5	1.5×5	0.7	32	32	0.25{2.5}	20~32	0.19{1.9}	62	90.8
			KF2-40R5(6)E2.5	2.2×5	0.7	48	48	0.38{3.9}	30~48	0.29{3.0}	62	91.7
			KF2-40R5(6)E3.7	3.7×5	0.8	65	65	0.54{5.5}	44~65	0.42{4.3}	66	92.7
			KF2-40R5(6)E5.5	5.5×5	1.0	80	80	0.67{6.8}	60~80	0.58{5.9}	69	93.4
125	50		KF2-50R5(6)E2.5	2.2×5	0.98	32	32	0.25{2.5}	20~32	0.19{1.9}	64	91.7
			KF2-50R5(6)E3.7	3.7×5	1.17	48	48	0.38{3.9}	30~48	0.29{3.0}	66	92.7
			KF2-50R5(6)E5.5	5.5×5	1.3	70	70	0.58{5.9}	44~70	0.50{5.1}	68	93.4
			KF2-50R5(6)E7.5	7.5×5	1.48	80	80	0.67{6.8}	60~80	0.58{5.9}	69	93.6
150	65		KF2-65R5(6)E3.7	3.7×5	1.87	32	32	0.25{2.5}	20~32	0.19{1.9}	65	92.7
			KF2-65R5(6)E5.5	5.5×5	1.62	48	48	0.38{3.9}	30~48	0.32{3.3}	67	93.4
			KF2-65R5(6)E7.5	7.5×5	1.9	60	60	0.49{5.0}	44~60	0.42{4.3}	70	93.6

Unit bore	Suction bore	Operation method	Model	Motor	Standard specification				Set head adjustable range	Accumulator charged pressure	Noise (*1)	Power factor
					Flow rate	Total head	Set head	Starting pressure				
mm	mm			kW	M^3/min	m	m	MPa {kgf/cm^2}	m	MPa {kgf/cm^2}	dB[A]	(%)
80	32	5/5, 5/6 pump rotary	KF2-32R6E0.75	0.75×6	0.325	32	32	0.25{2.5}	20~32	0.19{1.9}	60	-
			KF2-32R6E1.1	1.1×6	0.3	53	53	0.43{4.4}	30~53	0.33{3.4}	62	90.2
			KF2-32R6E1.9	1.9×6	0.3	65	65	0.54{5.5}	44~65	0.42{4.3}	62	90.2
100	40		KF2-40R6E1.5	1.5×6	0.7	32	32	0.25{2.5}	20~32	0.19{1.9}	62	90.8
			KF2-40R6E2.5	2.2×6	0.7	48	48	0.38{3.9}	30~48	0.29{3.0}	62	91.7
			KF2-40R6E3.7	3.7×6	0.8	65	65	0.54{5.5}	44~65	0.42{4.3}	66	92.7
			KF2-40R6E5.5	5.5×6	1.0	80	80	0.67{6.8}	60~80	0.58{5.9}	69	93.4
125	50		KF2-50R6E2.5	2.2×6	0.98	32	32	0.25{2.5}	20~32	0.19{1.9}	64	91.7
			KF2-50R6E3.7	3.7×6	1.17	48	48	0.38{3.9}	30~48	0.29{3.0}	66	92.7
			KF2-50R6E5.5	5.5×6	1.3	70	70	0.58{5.9}	44~70	0.50{5.1}	68	93.4
			KF2-50R6E7.5	7.5×6	1.48	80	80	0.67{6.8}	60~80	0.58{5.9}	69	93.6
150	65		KF2-65R6E3.7	3.7×6	1.87	32	32	0.25{2.5}	20~32	0.19{1.9}	65	92.7
			KF2-65R6E5.5	5.5×6	1.62	48	48	0.38{3.9}	30~48	0.32{3.3}	67	93.4
			KF2-65R6E7.5	7.5×6	1.9	60	60	0.49{5.0}	44~60	0.42{4.3}	70	93.6

(Note) ●Consult us separately in the case of using a large volume of water instantly such as a flush valve etc. (*1) reference value

3. Details of features

3-1) Energy saving of 40%

KF2/KF2-T/KF2-R Type with the constant estimated terminal pressure method has an energy saving effect of 40% compared to the conventional reducing valve method. (Refer to P.16)

Here, the principle of speed control and the difference between constant discharge pressure control and constant estimated terminal pressure control, and the comparison of concrete running costs are explained.

(1) Basic principle of speed control

Generally, a pump's characteristics change as follows if the rotation speed changes.

When changing the pump rotation speed from N_1 to N_2, the values shall be as below.

$Q_1/Q_2 = N_1/N_2$

$H_1/H_2 = (N_1/N_2)^2$

$P_1/P_2 = (N_1/N_2)^2$

Q_1: Water volume when the rotation speed is N_1

Q_2: Water volume when the rotation speed is N_2

H_1: Total head when the rotation speed is N_1

H_2: Total head when the rotation speed is N_2

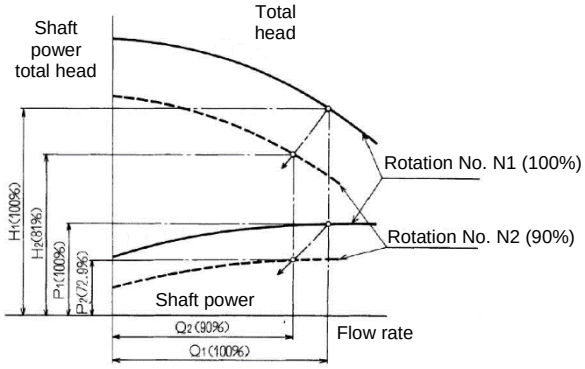
P_1: Shaft power when the rotation speed is N_1

P_2: Shaft power when the rotation speed is N_2

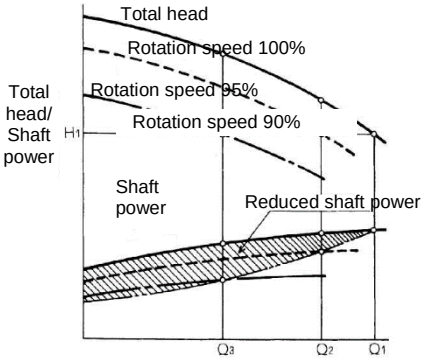
For example, when changing the rotation speed of the pump to

100%/95%/90%, each water volume, total head, and shaft power become as in Table 3-1. Drawing 3-1, 3-2 shows the characteristic change when changing the rotation speed of the pump from 100% to 90%, and it can be seen that it is possible to reduce the shaft power in the shaded area if changing the rotation speed against the change of flow and comparing the case to make the discharge pressure constant and the case to make the rotation speed constant.

Therefore, it is clear that the shaft power is reduced more in the case that the change of rotation speed of the pump is bigger compared to the change of flow.



[Drawing 3-1] Relationship between the pump's characteristics and rotation speed



[Drawing 3-2] Comparison of shaft power at the time of rotation speed change

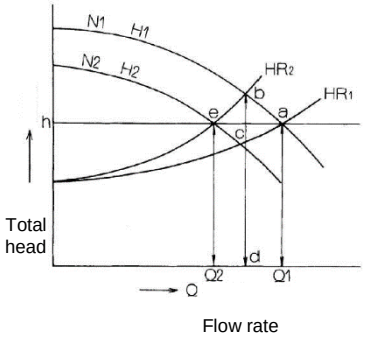
[Table 3-1] Unit: %

Rotation speed	Water volume	Total head	Shaft power
100	100	100	100
95	95	90	86
90	90	81	73

(2) Principle of constant discharge pressure control and the estimated terminal pressure control

●Constant discharge pressure control

The pump is connected to a variable speed motor to control the rotation speed depending on the water volume automatically and supports any change of the discharge pressure and flow. If the rotation speed of the pump is N_1, the characteristics of the pump are H_1, and if setting the piping resistance as HR_1, the operating point becomes a, and the flow rate becomes Q1 , the head becomes h. If the terminal valve is throttled to reduce the required water volume, the piping resistance becomes HR. If the rotation speed stays at N_1, the Flow rate by the pump becomes bd, and if decreasing the rotation speed to N_2, the pump's characteristics become H_2. The discharge pressure is the intersection point of H_2 and HR_2 (e), and the head is h, which means no change and remaining constant. The flow rate is Q_2.

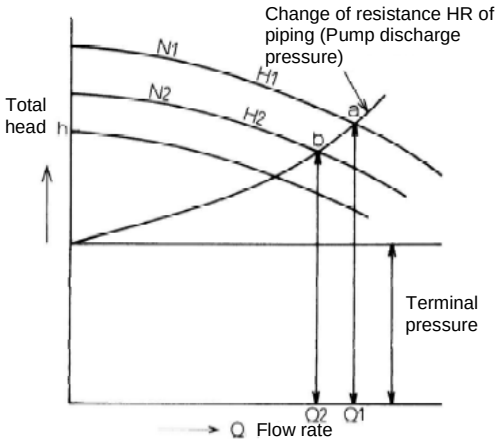


[Drawing 3-3]

●Constant estimated terminal pressure control

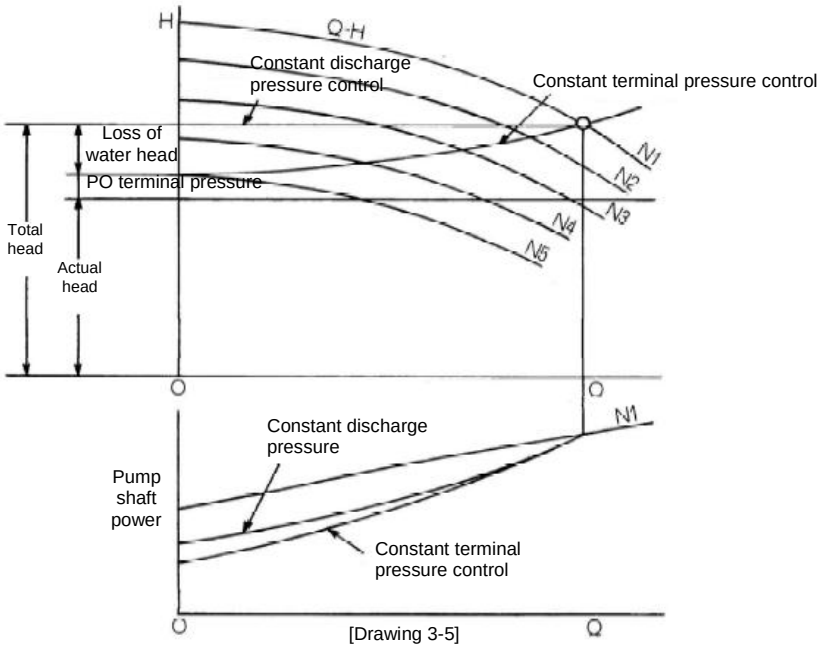
The terminal pressure varies depending on the piping route and water head loss. The water head loss depends on the loss due to wear and shape, but it is proportional to the in-piping flow (the square of the flow), so the water head loss is less in a small water volume area and it is possible to achieve a lower pump Flow rate.

In [Drawing 3-4], when the rotation speed of pump is N1, the pump's characteristics are H1, and the operating point of the pump is a, and the water volume is Q1. If the required water volume at the demand terminal decreases to Q2, the rotation speed becomes N2, the pump's characteristics become H2, and the operating point becomes b. Therefore, the constant estimated terminal pressure controls the discharge output variably as a square of the curve. The characteristic is that the variable range of terminal pressure is small.



[Drawing 3-4]

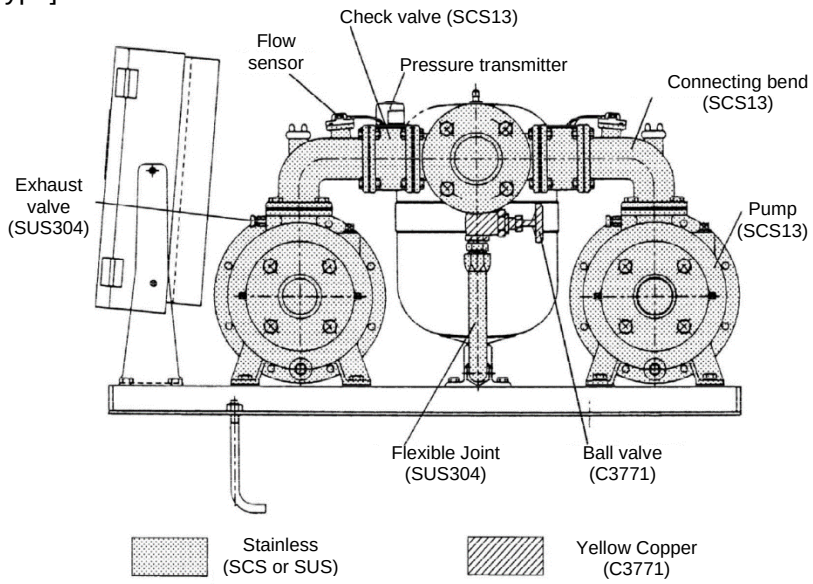
●Comparison between the total head-flow rate & shaft power-flow rate curves (Constant discharge pressure control and constant estimated terminal pressure control)



[Drawing 3-5]

3-2) Stainless precision casting
A stainless precision casting is adopted for the pump casing and flange, so resistance against stress and deformation is stronger than for pressed parts.
The material is stainless steel, so there is no worry regarding water, and it is possible to implement a clean water supply.

[Drawing of KF2 Type]



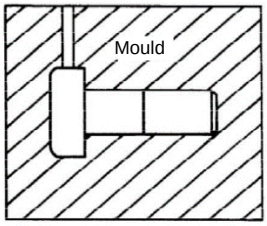
[Drawing 3-6]

[Reference]
Stainless castings are adopted for the pump casing etc. for the Pumper KF Series, and an overview of the lost wax casting method is as below.

(1) What is the “lost wax method”?
Make the product’s model with wax, cover it with slurry (particle refractory material mixed with caking coal) and the refractory material to be materials for the casting mould, and harden it by drying. By making a casting mould by repeating this process and melting and burning the wax in the burning process, it is possible to process fine grooves, etc. precisely. Therefore, the lost wax method is effective for products with complicated shapes that cannot be processed by a machine or products that become too expensive because of the processing work.

(2) Process
Explanation using a bolt with a simple structure (Not manufactured actually)

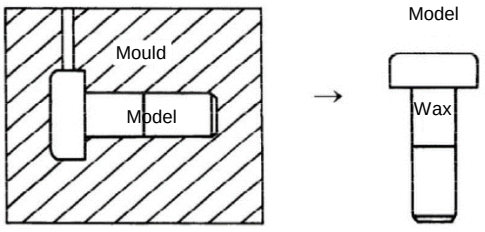
① Manufacturing of the mould : Mould



[Drawing 3-7]

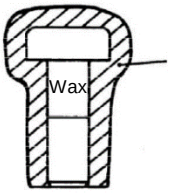
② Manufacturing model
Create a model by injecting wax into the mould.

Remove the model from a mould



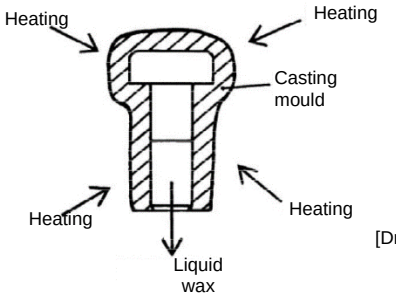
[Drawing 3-8]

③ Coating  Coating
Cover the model bolt with the refractory material (repeat a few times) and make the casting mould



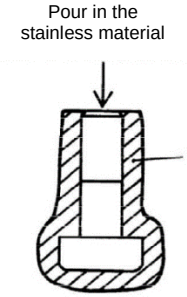
[Drawing 3-9]

④ Dewaxing
Once the coating work is completed, heat the wax inside the casting mould and liquidate.
(This is why this method is called the “Lost wax method”.)



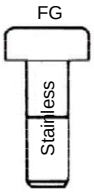
[Drawing 3-10]

⑤ Casting



[Drawing 3-11]

⑥ Finishing work
1. After casting, break the casting mould and remove the “casting”.
2. Finish by implementing surface finishing as necessary.



[Drawing 3-12]

(3) Comparison between the lost wax method and sand mold casting

[Drawing 3-3] ◎: Excellent ○: Good △: Inferior

Item	Lost wax	Sand mold casting
Mould cost	△	◎
Mould durability	◎	△
Dimensional precision	○	△
Surface roughness	○	△
Shape difficulty	◎	△
Cost	△	○

(4) Reasons why the lost wax method is adopted (feature)

1 It is possible to apply integrated molding to complicated shapes
2 It is possible to achieve a casting with good mechanical characteristics
3 The dimensional precision and surface roughness are good
4 Because the fluidity is good, thin wall design is possible.
5 Compared to pressing,

- Higher strength and resistance against piping stress
- High flexibility of shapes
- No corrosion cracking due to stress

(5) Parts for which the lost wax method is adopted

・Casing
・Casing cover
・Piping
・Flange

3-3) Silent operation

Silent operation is possible because of the adoption of the silent PWM inverter, the cast 3D impeller, highly rigid stainless casting casing, vibration proof rubber, and low speed rotation with a small water volume. Especially, the operation is silent at night when water consumption is less, so this product is suitable for the water supply unit to multiple dwelling houses. The overview is below.

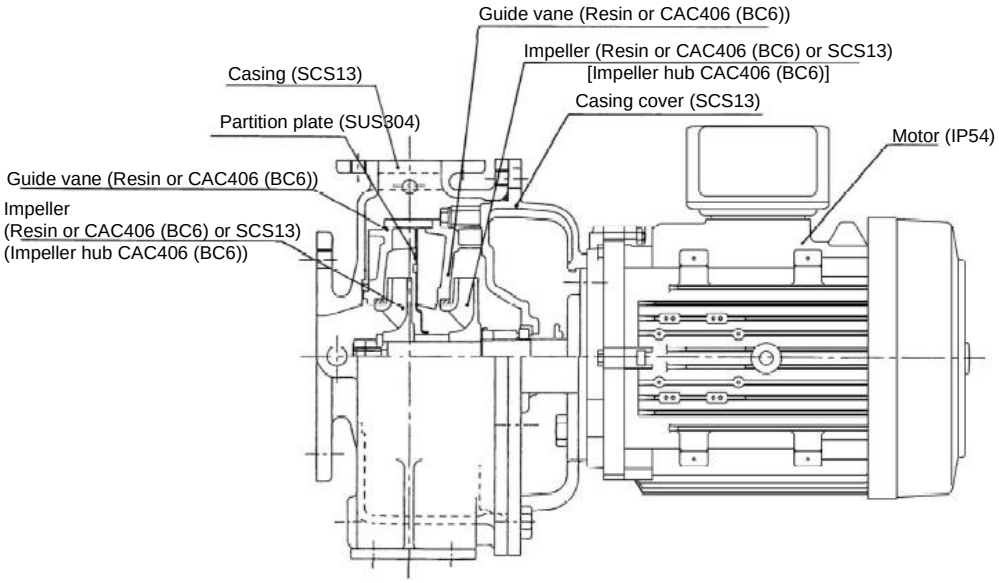
(1) Pump

① The noise is lower because of the adoption of the high efficiency cast 3D impeller.

② Any flowing water sound and collision sound are reduced because the power per impeller is lower and the water flow speed is lowered by the multistage operation.

③ Because of the double casing, any noise from the impeller and the guide vane do not go out directly. Because of this, any flowing water sound at the main body of the pump is barely heard.

④ The noise is suppressed by using a 60Hz pump (common for 50Hz/60Hz) for the main pump. Because the drainage gap of the 60Hz pump is wider, it is silent.



[Drawing 3-13]

3-4) Specification of the control panel

・The system for the KF2 Type is reliable because the automatic alternate operation function works by mutual communication between the inverters even if a pump's system is down.

For KF2-A/P (Alternate/Alternate & Parallel)

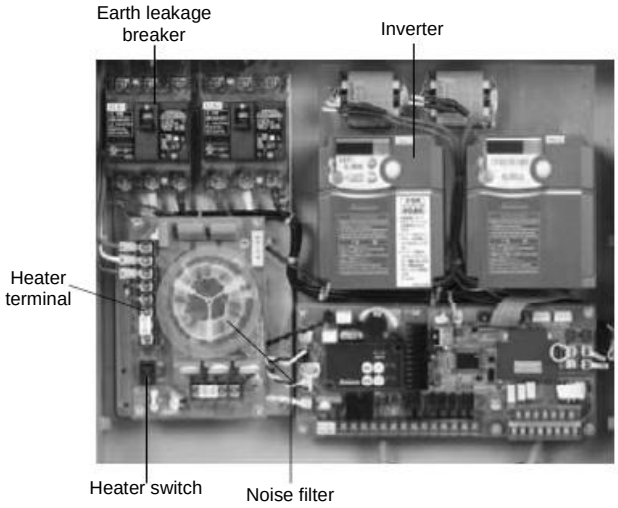
ECSG2 Type (0.4, 0.75kW)

ECSG3 Type (1.1-7.5kW)

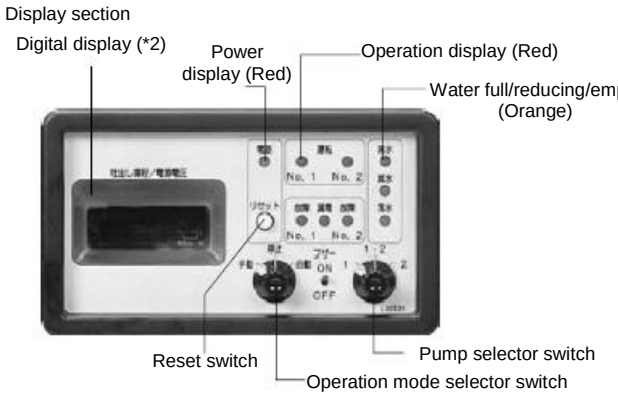
●Display content

※1	Electrical current, Power, Voltage, Frequency
※2	Power voltage, Discharge lifting height Cumulative operation time/number of times of starting

Picture: Example of ECSG3 (3.7kW)



*ECSG3 (1.1-7.5kW) has the same emergency operation function as the ECSG3-T (P10).



●Inverter for each pump, DC reactor, Earth leakage breaker
●Noise filter
●Emergency operation function (1.1-7.5kW)
●Double tank inflow electromagnetic valve circuit (1.1kW or higher)
●Supports a double water tank (5 electrodes) (1.1kW or higher)

Model		ECSG2-3-A·P	
Output		0.75kW or lower	1.1kW or higher
Operation method		A: Alternate, P: Alternate & Parallel	
Rated voltage		1PH220V or 3PH380V	
Installation location		Indoor, Altitude: 1,000m or lower, Ambient temperature: 0-40℃, Humidity 90% or lower	
Major parts	Earth leakage breaker (with AL)	For each pump	
	DC reactor	For each pump	
	Noise filter	Common for main circuit/control circuit	
	Inverter	For each pump	
	Control board	With water level relay	
Operation display	Power	Indicator lamp	
	Operation	Indicator lamp (for each pump)	
	Discharge lifting height	Digital	
	Power voltage, Electric current, Frequency	Digital	
	Cumulative operation time/number of times of starting	Digital	
Failure display	Failure	Indicator lamp (for each pump)	
	Pressure lowering	Indicator lamp (Failure message)	
	Electric leakage	Indicator lamp	
	Pressure transmitter failure	Indicator lamp (Failure message)	
	Water full/reducing/empty	Indicator lamp *1	Indicator lamp
Function	Water level control	○Single tank type (4/5 electrodes *1)	○ Double tank (5 electrodes)
	Inflow electromagnetic valve control	Special accessory	○ Double tank (3 electrodes)
	Pump failure	○ (Automatic alternate operation)	
	Inverter failure	○ (Automatic alternate operation)	
	Malfunction prevention retry	○ (Refer to the table below)	
	Buzzer	○ (With ON/OFF switch)	
	Emergency operation function	-	○ (No. 1 inverter) *2
External non-voltage signal	Operation	○ (Lump)	○ (Individual)
	Failure	○ (Individual)	○ (Individual)
	Water full	○	○
	Water reducing	○ (*2)	○
	Water empty	○	○

(*1) In the case of adding a level relay (special accessory, 1 unit)
(*2) 1.1-7.5kW

■Failure messages (In case of KF2 Type (1.1kW or higher))

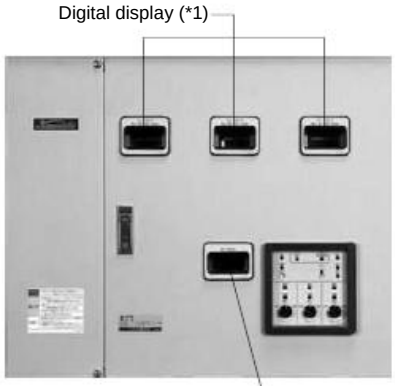
Item		Lamp item	Failure message	External output (Individual failure)	Retry
Inverter	Overload	○Failure	*0C1 ~3	○	○
	Binding/Open-phase				
	Ground fault				
	Overvoltage/Lack of voltage	○Failure (Overvoltage)	0V·LV	○	○ (Overvoltage)
	Inverter heating	○Failure	0H1	○	-
Memory abnormal		○Failure	Er1	○	○
Pressure lowering		○Failure	HdL	○	○
Pressure transmitter failure		○Failure	PEd	○	-

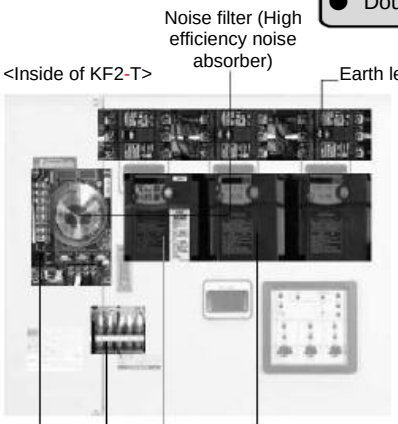
(*) The overload protection by the electronic thermal is the OL display. (No retry)

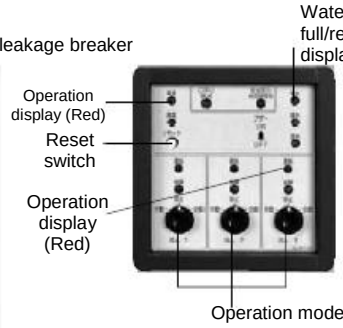
The picture the ECSG2 (0.75kW or lower)

For KF2-T (3 rotary units)
ECSG3-T Type (0.75kW-3.7kW)

- Inverter for each pump, DC reactor, Earth leakage breaker
- Noise filer, Double tank type inflow electromagnetic valve circuit
- Double tank type water tank (5 electrodes)

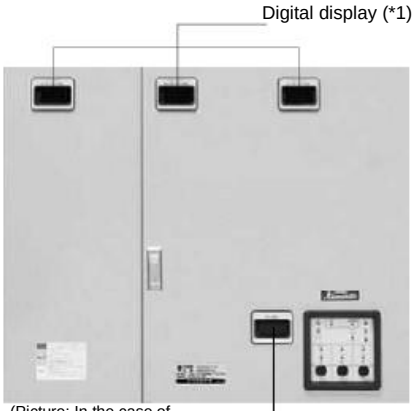


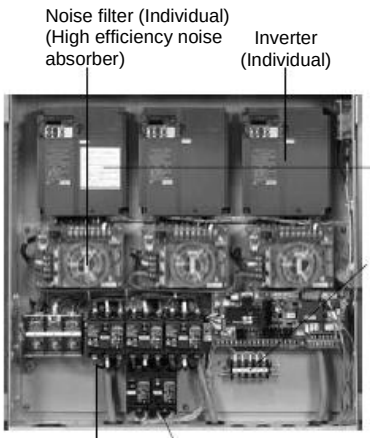




<Emergency operation function>
No. 1 pump manual operation switch preventing water supply failure at the time of control board failure

ECSG3-T Type (5.5kW-7.5kW)





●Display contents

※1	Electrical current, Power, Voltage, Frequency
※2	Lifting height, Power voltage

<Emergency operation function>
No. 1 pump manual operation switch preventing water supply failure at the time of control board failure

- ●Inverter for each pump, DC reactor, Earth leakage breaker
- ●Noise filer, Double tank type inflow electromagnetic valve circuit
- ●With emergency operation function (1.5-7.5kW)
- ●Double tank type water tank (5 electrodes)

Measure against lightning

The measure against lightning surge is taken for "KFR2/KF2-R" as standard. However, in the case of a special installation location (mountain peak etc.) or big grounding resistance, the effect of the lightning absorbing device lowers, so ground the grounding line (1 point) at the shortest distance, and execute C type grounding work from this device.

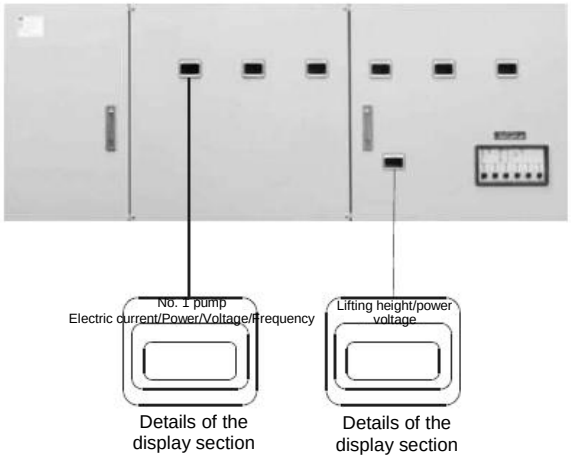
Model		ECSG3-T			
Operation method		Multiple units rotary [2/3. 3/3 units (standard)]	Failure display	Failure	Indicator lamp (for each pump)
				Electric leakage	Indicator lamp
Installation location		Outdoor, Altitude: 1,000m or lower, Ambient temperature: 0-40℃, Humidity 90% or lower		Pressure transmitter failure	Indicator lamp (Failure message)
				Water full/reducing/empty	Indicator lamp
Main parts	Earth leakage breaker (with AL)	For each pump	Function	Water level control	○ (Double water tank type (5 electrodes))
	DC reactor	For each pump		Support for positive suction electromagnetic valve	○ (Double water tank type (3 electrodes))
	Noise filter	○High efficiency noise absorber		Pump failure	○ (Automatic Alternate operation)
	Inverter	For each pump		Inverter failure	○ (Automatic Alternate operation)
	Control board	Control board, Display board		Discharge pressure transmitter failure	○
Operation display	Power	Indicator lamp		CPU abnormality	○
	Operation	Indicator lamp (for each pump)		Buzzer	○ (With ON/OFF switch)
	Discharge head	Digital	External non-voltage signal	Emergency operation function	○ (No. 1 inverter) *1
	Voltage, Electric current. Frequency	Digital		Operation	○ (Individual)
	Cumulative operation time/number of times of starting	Digital		Failure	○ (Individual)
				Water full	○
				Water reducing	○
				Water empty	○

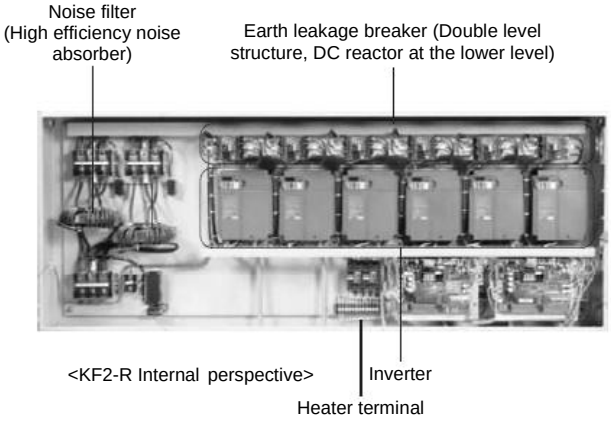
■Failure messages

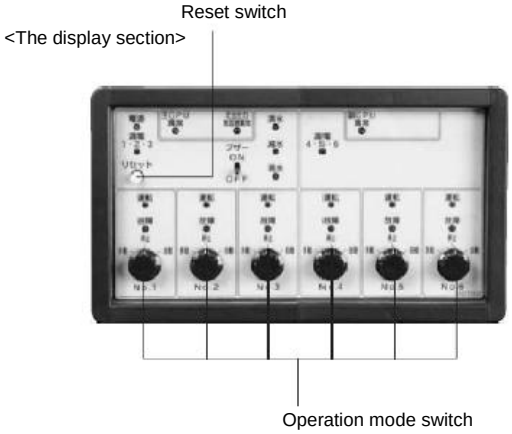
Item		Lamp display	Failure message	External output (Individual failure)	Retry
Inverter	Instant overvoltage protection (Binding. Short-circuit on output side, Ground fault)	○Failure	0C1~3	○	○
	Electronic thermal operation (Overload)	○Failure	0L1/0LU	○	-
	Voltage shortage protection	○Failure	LU	○	-
	Overvoltage protection	○Failure	0U1~3	○	○
	Output open-phase protection	○Failure	0PL	○	-
	Overheating protection	○Failure	0H1	○	-
	Memory abnormality	○Failure	Er1	○	-
	Inverter CPU abnormality	○Failure	Er3	○	-
	Communication abnormality	○Failure	Er8	○	-
	Data save error at the time of voltage shortage	○Failure	ErF	○	-
Pressure reduction		○Failure	HDL	○	○
Pressure transmitter abnormality		○ Discharging pressure transmitter abnormality	PEd	○	-
Control board CPU abnormality		○ CPU abnormality	CPE	○	-
Big water volume operation		-	PE2	-	-

(*1) 1.5-7.5kW

●The secure backup function by mutual communication of the control section, inverter section, and pump section is adopted for the KF2-R Type (control for the number of units)
(Refer to P. 24 for details)
ECSG3-R Type
(The picture is the 3.7kW for 6-unit operation)







●Inverter for each pump, DC reactor, Earth leakage breaker
●Noise filer, Double tank type inflow electromagnetic valve circuit
●Double tank type water tank (5 electrodes)
●Backup function at the time of pressure transmitter failure/control board failure

Model		ECSG3-R
Operation method		Multiple rotary units (3-6 units)
Rated voltage		3PH380V
Installation location		Indoor, Altitude: 1,000m or lower
		Ambient temperature: 0-40℃,Humidity: 90% or lower
Main parts	Earth leakage breaker (with AL)	Pump, Control circuit. Heater circuit, Inflow electromagnetic valve circuit
	DC reactor	For each pump
	Noise filter	High efficiency noise absorber (Common for main circuit and control circuit)
	Inverter	For each pump
	Control board	Control board, Display board, Water level board
Operation display	Power	Indicator lamp
	Operation	Indicator lamp (for each pump)
	Discharge lifting height	Digital
	Power voltage, Electric current, Frequency	Digital
	Cumulative operation time/number of times of starting	Digital
Failure display	Failure	Indicator lamp (for each pump)
	Pressure lowering	Indicator lamp (Failure message)
	Electric leakage	Indicator lamp (Failure message)
	Pressure transmitter failure	Indicator lamp (Failure message)
	Water full/reducing/empty	Indicator lamp
Function	Water level control	○ (Double water tank type (5 electrodes))
	Inflow electromagnetic valve	○Double water tank type (3 electrodes)
	Pump failure	○ (Backup operation (Overload/Binding/Open-phase/Short-circuit)
	Inverter failure	○ (Backup operation)
	Malfunction prevention retry	○ (Refer to the table below)
	Pressure transmitter failure	○ (Backup operation)
	Control board failure	○ (Backup operation)
External non - voltage signal	Operation	○ (With ON/OFF switch)
	Operation	○ (Individual)
	Failure	○ (Individual)
	Water full	○
	Water reducing	○
	Water empty	○

■Failure messages (KF2-R Type)

	Item	Lamp display	Failure message	External output	Retry	Backup operation
Inverter	Overload	○Failure	0L	○	○	○
	Binding/Open phase	○Failure	0C1~3	○	○	○
	Ground fault	○Failure	0C1~3	○	○	○
	Overvoltage	○Failure	0U1~3	○	○	○
	Inverter heating	○Failure	0H1	○	○	○
Pressure lowering		○Failure	HdL	○	○	○
Pressure transmitter failure		○Failure	PEd	○	-	○
Control board failure		○Failure	CPE	○	-	○

Backup operation	Continue the operation by selecting normal control board/inverter/pump automatically at the time of a failure.

Measure against lightning

The measure against lightning surge is taken for “KF2/KF2-R” as standard. However, in the case of a special installation location (mountain peak etc.) or big grounding resistance, the effect of the lightning absorbing device lowers, so ground the grounding line (1 point) at the shortest distance, and execute C type grounding work from this device.

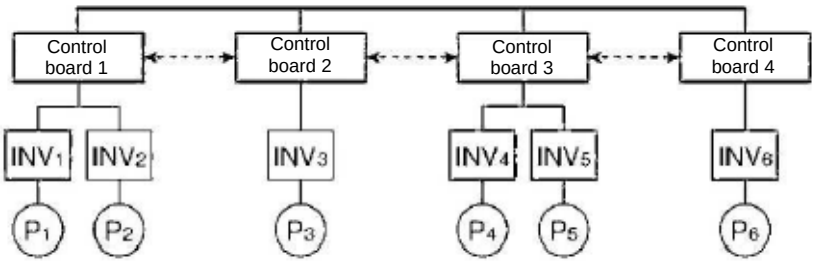
3-4-1) Backup function (KF2-R Type)

The backup function below is adopted for the KF2-R Type to avoid a water failure as much as possible and keep supplying water.

1) Content
   Select a normal device automatically and continue operating in case a failure of the pump, inverter, or control board occurs.
2) Backup devices
   ・Inverter (for each pump) (3 - max. 6 units)
   ・Control board (Microcomputer) 2 or 3 units
   The pump operation software is installed in each control board.
   One control board can control a maximum of two pumps.

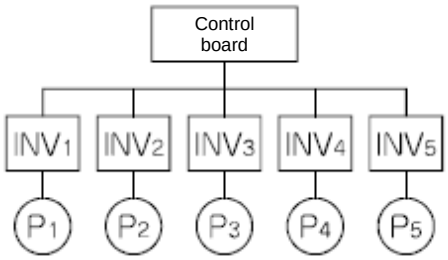
Number of devices for backup	KF2-R	Company A	Company B
Control board (Microcomputer)	Max. 3	1 unit	1 unit
Inverter	Max. 6	Max. 5	Max. 5
Pump	Max. 6	Max. 5	Max. 5

3) Device structure (For 6 rotary units operation)



If a failure of control board 3 occurs in the drawing at left, the operation is continued by control boards 1, 2 and 4.
(Mutual communication at the ↔ section)
Water supply is implemented at the maximum of 4/6 (67%), and water supply failure is avoided.

<Reference> In the case of one control board



・In the case of the drawing at left, if a failure of the control board occurs, all the pumps become inoperable, causing a water supply failure.

4) Backup contents

No.	Content	Existence/Non-existence of backup		
		KF2-R	Company A	Company B
1	Inverter failure	○	○	○
2	Pressure	○	○	○
3	Pressure drop	○	X (Water failure)	X (Water failure)
4	Control board failure	○	X (Water failure)	X (Water failure)

Backup No. 1: At the time of inverter failure
Skip a broken inverter (pump) and implement rotary operation with the other inverters (pumps) to continue the water supply.
Backup No. 2: At the time of pressure drop
Skip a broken pump (inverter) and implement rotary operation with the other pumps (inverters) to continue the water supply.
Backup No. 3: At the time of pressure transmitter failure
Implement constant speed operation with the inverter and backup operation with the flow sensor of each pump to continue the water supply.
Backup No. 4: At the time of control board failure
Skip the broken control boards (inverter, pump) and implement the backup operation with the other control boards (inverters, pumps) to continue the water supply.

Function comparison table

■KF2 Type

		KF2			Company A		Company B	
Port diameter range		32 mm	32 ~ 65 mm	○	25 ~ 65 mm	◎	25 ~ 65 mm	◎
Output range		0.4, 0.75kW	1.1 ~7.5kW	○	0.4 ~ 7.5kW	○	0.4 ~ 7.5kW	○
Motor		TEFC		○	TEFC	○	TEFC	○
Check valve		With bypass		◎	Without bypass	○	Without bypass	○
Control panel	Noise filter	Has		○	Has	○	Has (only for control)	△
	Reactor	Standard installation of DC reactor		◎	Option (ACR)	△	Option (ACR)	△
	Operation display	Electrical current frequency Discharge head Power voltage Cumulative operation time Cumulative number of times of starting		◎	Electrical current frequency Discharge head Power voltage	○	Electrical current frequency Discharge head Power voltage Cumulative operation time Cumulative number of times of starting	◎
	Failure display	Inverter failure Voltage reduction Electrical leakage, Water full/empty Pressure transmitter failure		◎	Inverter failure Voltage reduction Electrical leakage, Water full/empty, Water reducing	○	Inverter failure Voltage reduction Electrical leakage Water full/empty Pressure transmitter failure	○
		(Water reducing) Option	○ Water reducing	◎				
	Buzzer	Has		◎	Has	◎	Has	◎
	External output	Operation pump	○ Operation individual	◎	Individual operation Individual failure Water full/empty/reducing	◎	Individual operation Individual failure Water full/empty/reducing	○
		Individual failure, Water full/empty		◎				
		(Water reducing)	○ Water reducing	◎				
	Water tank	Single tank	○ Double tank	◎	Double tank	◎	Double tank	◎
	Positive suction valve circuit	Variation	○ Positive suction electromagnetic valve	◎	Positive suction electromagnetic valve	○	Positive suction electromagnetic valve	○
	Heater mounting terminal	Standard (with switch)		◎	Standard (no switch)	○	Option	△

■KF2-T Type

			KF2-T		KF2-R3		Company A	
Maximum number of units to be operated			3 units (2/3)		3 units (2/3)		3 units (2/3)	
Port diameter range			32~65mm	○	32~65mm	○	25~65mm	◎
Output range			0.75~7.5kW	△	0.75~7.5kW	○	0.4~7.5kW	○
Motor			TEFC	○	TEFC	○	TEFC	○
Unit	Sluice valve		Has	◎	Has	◎	None	△
	Check valve		With bypass	◎	With bypass	◎	Without bypass	○
	Accumulator		10 ℓ (20 ℓ is mountable also)	○	20 ℓ ×1	○	10 ℓ ×1	○
		Drain	Ball valve (with PT3/8×Screw)	◎	Ball valve (Drain by tube)	◎	Ball valve (with PT3/4×Screw)	◎
	Pressure gauge		Has (with digital display)	○	Has (with digital display)	○	None (with digital display)	○
Control panel	Noise filter		Has (with high noise absorbing material)	◎	Has (with high noise absorbing material)	◎	Has	○
	Reactor		DC reactor standard	◎	DC reactor standard	◎	Option (ACR)	△
	Operation display		Electrical current, Frequency discharge, Head Power, Power voltage	○	Electrical current, Frequency discharge, Head Power, Power voltage	○	Electrical current frequency Power voltage	△
	Failure display		Individual operation Pressure drop, Electric leakage Pressure transmitter failure Water full/reducing/empty Control board failure	◎	Individual operation Pressure drop, Electrical leakage Pressure transmitter failure Water full/reducing/empty Control board failure	◎	Individual operation Pressure drop Electrical leakage Water full/reducing/empty	○
	Maintenance data		Failure history Cumulative operation time Cumulative number of times of starting	◎	Failure history Cumulative operation time Cumulative number of times of starting	◎	None	×
	Buzzer		Has	○	Has	○	None	△
	External output		Individual operation Individual failure Water full/reducing/empty	◎	Operation pump Failure (pump and individual) Water full/reducing/empty	○	Operation pump Pump failure Water full/reducing/empty	○
		Control board failure	Failure of individual total output	○	Pump output failure	○	None	×
	Liquid level control		Double tank, 5P	○	Double tank, 5P	○	Double tank, 5P	○
	Positive suction valve circuit		Positive suction electromagnetic valve	◎	Positive suction electromagnetic valve	◎	Positive suction electromagnetic valve	○
	Heater mounting terminal		Standard (with switch)	○	Standard (with ELB)	◎	Standard (without switch)	△
	Backup	Pressure transmitter failure	Single constant speed operation (Manual)	△	Constant speed operation after increasing the number of units	○	None	×
		Control panel failure			Operate with a normal motor	○		
	Maintainability	Pump	Good workability (mechanical replacement etc.)	◎	The panel is located at the upper section of the motor	○	The panel is located at the upper section of the motor	○

		Control panel	Base installation	◎	Located at the upper section of the motor (Long sideways)	◎	Located at the upper section of the motor (Long sideways)	◎

Note: The port diameter is the diameter of the suction pump port.

KF2-R Type

		KF2-R		Company A		Company B	
Maximum number of units		6 units	◎	5 units	○	5 units	○
Port diameter range		32-65mm	○	25-65mm	◎	40-65mm	△
Output range		0.7507.5kW	○	0.4-7.5kW	○	1.1-7.5kW	△
Motor		TEFC	○	TEFC	○	TEFC	○
Unit	Sluice valve	Has	◎	None	△	None	◎
	Check valve	With bypass	◎	Without bypass	○	Without bypass	○
	Accumulator	20L×1	○	10L×1	△	20L×1	○
	Piping	Stainless	○	Stainless	○	Stainless	○
Control panel	Noise filter	Has (High noise absorbing material)	◎	Has	○	Only for control	○
	Reactor	DC reactor standard	◎	Option (ACR)	△	Option (ACR)	△
	Operation display	Electrical current frequency Discharge head Power voltage	○	Electric current frequency Power voltage	△	Electric current frequency Discharge head Power voltage	○
	Failure display	Inverter failure Pressure drop, Electrical leakage Pressure transmitter failure Control board failure Water full/reducing/empty	◎	Inverter failure Pressure drop, Electrical leakage Water full/reducing/empty	○	In addition to the left, Starting frequency abnormality Cooling fan abnormality etc.	◎
	Maintenance data	Failure history Cumulative operation time Cumulative number of times of starting	◎	None	×	Failure history Cumulative operation time Cumulative number of times of starting	◎
	Buzzer	Has	○	None	△	Has	○
	External output	Pump operation Failure of pump/individual Water full/reducing/empty	◎	Pump operation Failure of pump Water full/reducing/empty	○	Pump operation Failure of pump, Trouble Water full/reducing	○
	Liquid level control	Double tank type, 5P	○	Double tank type, 5P	○	Double tank type, 5P	○
	Positive suction valve circuit	Positive suction electromagnetic valve	◎	Positive suction electromagnetic valve	○	Positive suction electromagnetic valve	○
	Heater mounting terminal	Standard (with ELB)	◎	Standard	○	Option	△
Maintenance		Wider space between pumps	◎	Narrow space between pumps	△	Narrow space between pumps	△
Backup		Inverter failure Pressure drop Pressure transmitter failure Control board failure	○	Only inverter failure Pressure drop	△	Only inverter failure Pressure drop	△

Note: The port diameter is the diameter of the pump's suction port.

3-5) Pointless sensor

① Adoption of a pressure transmitter

The pressure transmitter used for the Pumper KF is a high performance unit and is highly reliable in a harsh environment.

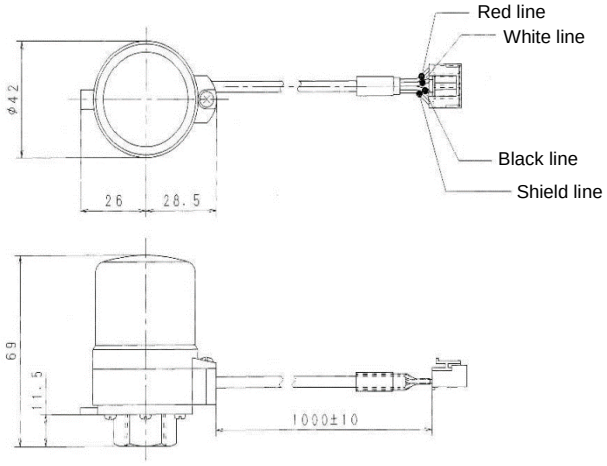
(1) Features

① Good durability and stability

② High vibration and shock resistance because of no moving parts

③ Small and light

(2) Specification and dimensions (For KF2 Type)



Specification

1 Rated voltage: DC12V

2 Output form: DC1-5V

3 Maximum working pressure: 0.97MPa (9.9kgf/cm^2)

4 Pressure change: Within -$^{0}_{3}$%

5 Noise resistance: 1500V×1μ sec

Line colour	Connector Pin No.	Terminal
Red	1	Power (Plus)
White	2	Power (Minus)
Black	3	Common
Shield	4	Earth

② Pointless flow sensor

(1) Features

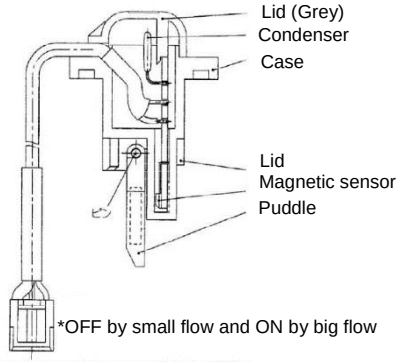
① Long life because of a pointless sensor incorporating a magnetic sensor.

② The resistance loss is less.
The resistance loss head H=0.1m until Q=0.3 m^3/min

③ Puddle method (patent pending)

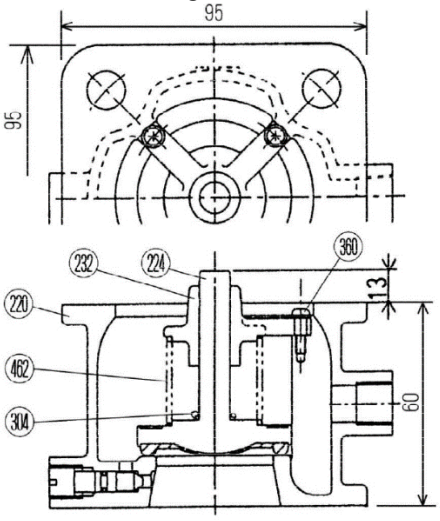
④ Small and light

⑤ High corrosion resistance because the case and puddle are made of resin, and the pin is made of SUS304.



3-6 Adoption of a shock-less valve preventing water hammer

This is a spring type check valve to prevent water hammer. This valve prevents water hammer caused by quick valve closing.



No.	Name	Material
220	Valve box	SCS13
224	Valve body	CAC406(BC6)
232	Valve guide	CAC406(BC6)
304	O-ring	Rubber (1A)
360	Small screw built-in washer	SUS304
462	Spring	SUS304-WPA

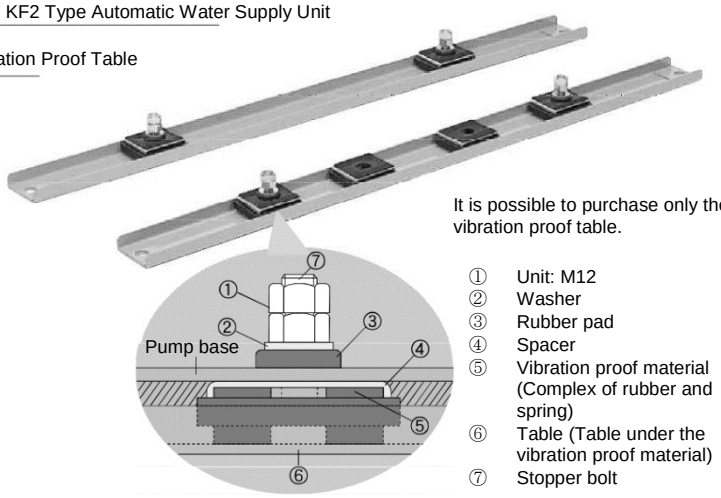
Specification Item	Content
(1) Nominal diameter	40A, 50A
(2) Nominal pressure	7K
(3) Max. allowable pressure	0.98Mpa (10kgf/cm^2)
(4) Working temperature	0~85℃
(5) Liquid name	Clean water

3-8) Special specification
With vibration proof function (Only KF2 Type)

- Setting of the pump and vibration proof table is unnecessary, and labour saving of vibration proof execution is achieved.
- The vibration insulation efficiency is 80% or more (the vibration transmission rate is less than 20%), and complies with the Ministry of Land, Infrastructure and Transport (*) specification.
- A vibration resistance stopper is installed normally. (Horizontally: 1G, Vertically: 0.5G))

■Specification of the vibration proof table

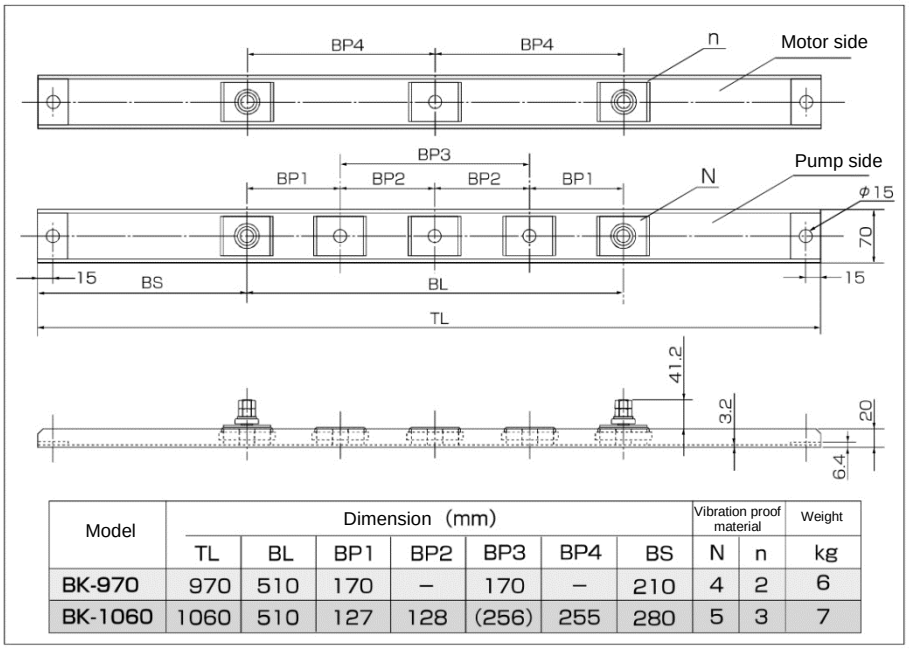
Model	BK Type		
Vibration insulation efficiency	80% or more (Vibration transmission rate: 20% or less)		
Vibration resistance stopper	4-M12 Bolt (SUS304) Horizontally: 1G, Vertically: 0.5G		
Number of vibration absorbing bodies (Combination with the water supply unit	Pump side	Motor side	Applicable vibration proof table
	4	2	BK-970
	5	3	BK-1060



It is possible to purchase only the vibration proof table.

① Unit: M12
② Washer
③ Rubber pad
④ Spacer
⑤ Vibration proof material (Complex of rubber and spring)
⑥ Table (Table under the vibration proof material)
⑦ Stopper bolt

■Dimensional outline drawing: As for the setting dimensions with the water supply unit, request the delivery specification separately.



Model	Dimension (mm)							Vibration proof material		Weight
	TL	BL	BP1	BP2	BP3	BP4	BS	N	n	kg
BK-970	970	510	170	–	170	–	210	4	2	6
BK-1060	1060	510	127	128	(256)	255	280	5	3	7

■Applicable unit

Model of vibration proof table	Model of applicable unit	Motor output (kW)
BK-970	KF2-A・P	0.4~3.7
BK-1060	KF2-A・P	5.5~7.5

■Vibration transmission rate (%)
Contact us if you need the calculation document.

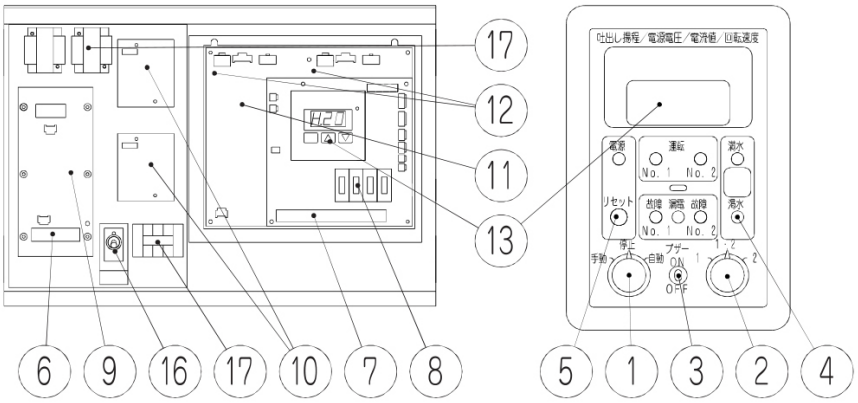
Frequency	Water supply unit model	Vibration transmission rate
50 Hz	KF2-A・P	2.79~6.80
60 Hz	KF2-A・P	2.79~6.80

Calculated for the standard specification

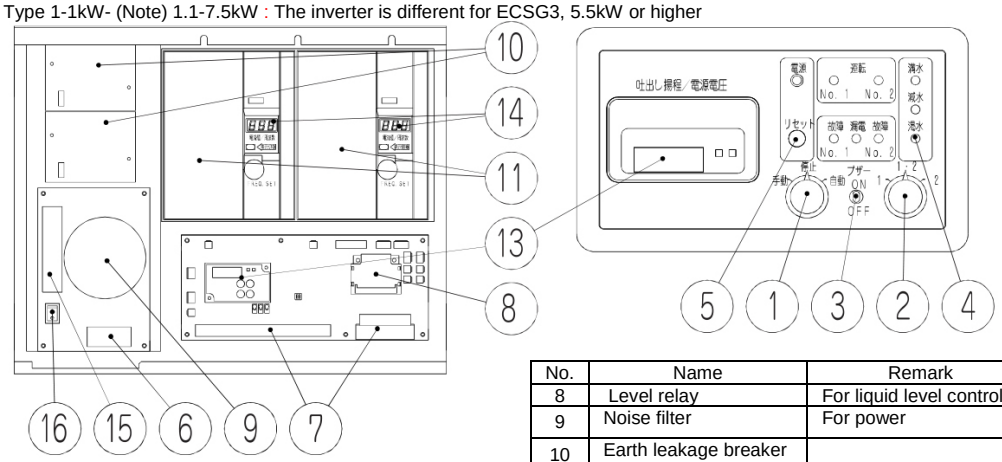
"The specific insulation efficiency shall be 80% or higher unless otherwise indicated in the "Machinery/Equipment Common Specification (1997) Version 5 Water Supply/Drain Sanitary Equipment Work Charter 2 Execution" supervised by the Maintenance Department, Ministry of Construction. Follow the operation manual for usage guidance.

4. Control panel layout drawing example.
Detailed drawing of the control panel ECSG$^{2}_{3}$

(1) For KF2 Type -0.75kW



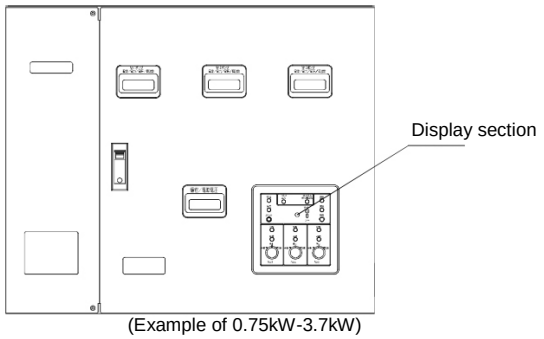
(2) For KF2 Type 1-1kW- (Note) 1.1-7.5kW : The inverter is different for ECSG3, 5.5kW or higher



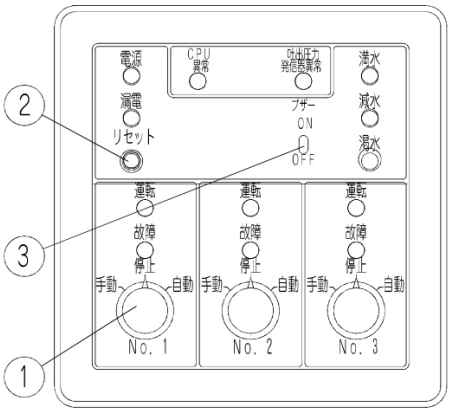
No.	Name	Remark
1	Switch SW1	Manual-Stop-Auto
2	Switch SW2	For switching Pump 1/Pump 2
3	Switch	Buzzer ON/OFF
4	Display lamp	Power, operation, failure etc.
5	Reset button	Failure reset
6	Terminal block	For power
7	Terminal block	For input/output signal

No.	Name	Remark
8	Level relay	For liquid level control
9	Noise filter	For power
10	Earth leakage breaker	
11	Inverter section	
12	Charge lamp	-0.75kW
13	Display panel	For the control section
14	Display panel	For inverter (1.1kW-)
15	Terminal block for heater	To connect heater/thermostat
16	Switch	Heater output ON/OFF
17	Reactor	Lower section of noise filter for 1.1kW-

(3) For KF2 Type Detailed drawing of the control panel ECSG3

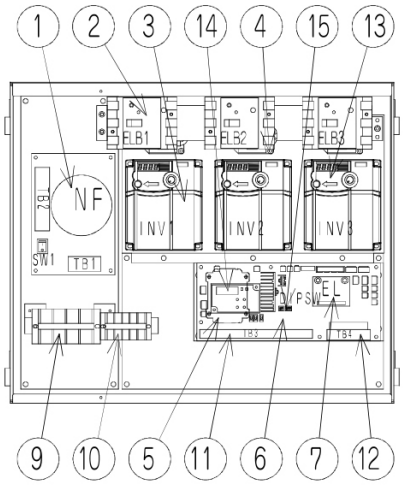


(Example of 0.75kW-3.7kW)



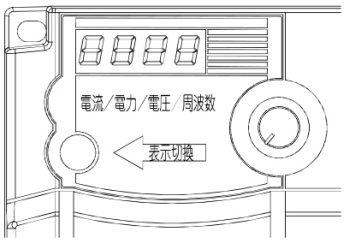
Detail of the display section

No.	Name	Remark
1	Select switch	Manual-Stop-Auto
2	Reset switch	Failure reset
3	Buzzer switch	ON/OFF

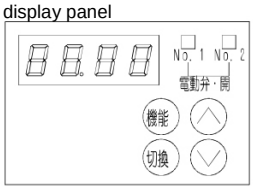


Example of unit for 0.75kW-3.7kW

13 Detailed drawing of the inverter display panel



14 Detailed drawing of the control board display panel

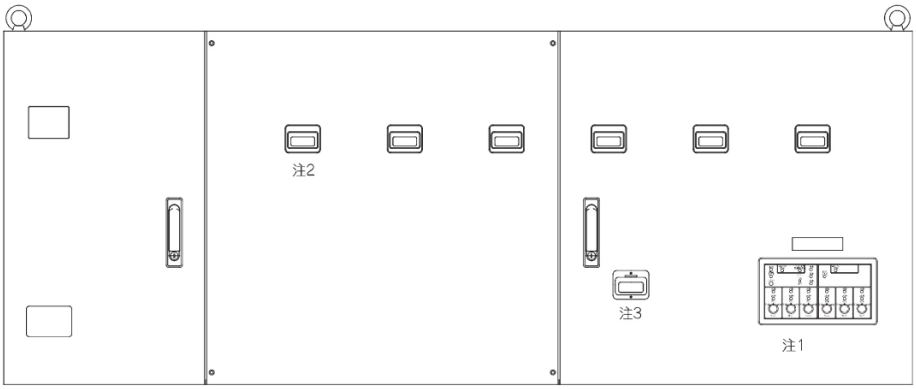


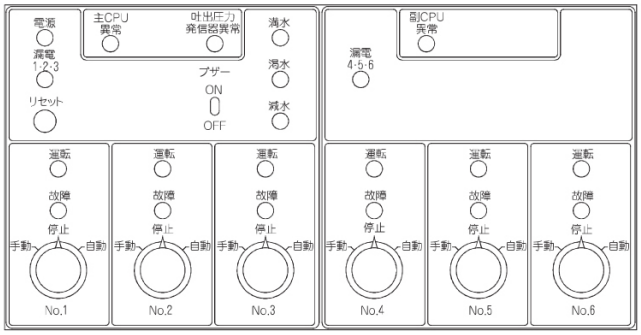
No.	Name	Remark
1	Noise filter	
2	Earth leakage breaker	ELB1~3
3	Inverter	INV1~3
4	DC reactor	(Under earth leakage breaker)
5	Trans	(Under control board)
6	Control board	
7	Level relay	
8	Fan	

No.	Name	Remark
9	Terminal block	Power
10	Terminal block	Heater
11	Terminal block	Various outputs
12	Terminal block	Liquid level control
13	Display panel for inverter	
14	Display panel for control board	
15	Switch for the electromagnetic valve/water tank	

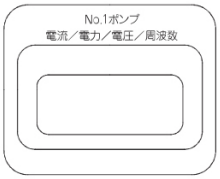
(4) KF2-R Type, Detailed drawing of the control panel ECSG3-R

■Front side

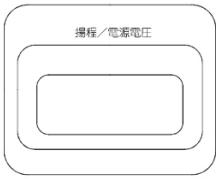




Note 1: Detail of the display section

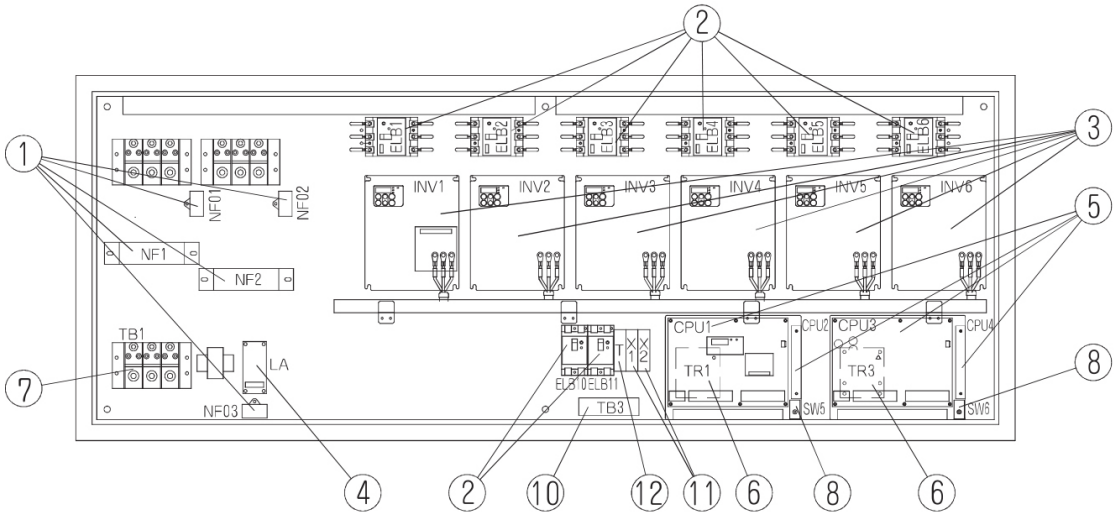


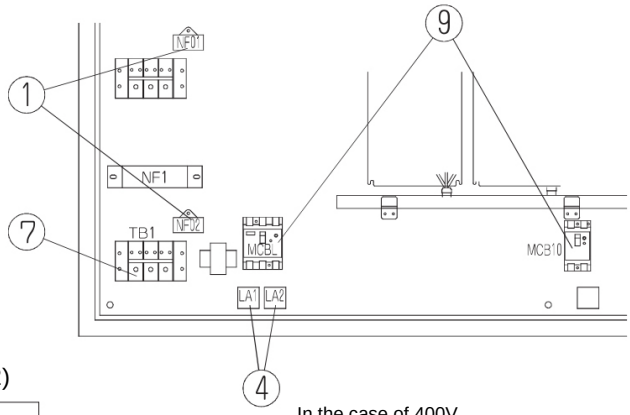
Note 2: Detail of the display section



Note 3: Detail of the display section

■ Control panel interior





In the case of 400V

TB1

R	S	T

TB3 (In the case of the 04 specification for C1-A42)

C1	C2	A41	A42	TH11	TH12	TH21	TH22	H11	H12	H21	H22	H31	H32

No.	Part name	Sign	Remark
1	Noise filter	NF1,2,01~03	
2	Earth leakage breaker	ELB1~6,10,11	
3	Inverter	INV1~6	
4	Lightning arrester	LA, LA1, 2	
5	Control board	CPU1~4	
6	Trans	TR1, 2	
7	Terminal block	TB1	
8	Switch	SW5,6	
9	Breaker for wiring	MCBL, MCB10	

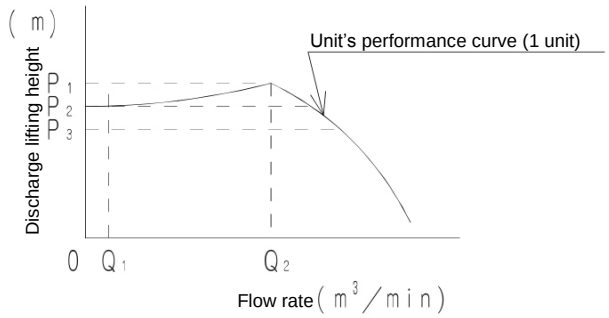
10	Terminal block	TB3	
11	Relay	X1,2	In the case of the 04 specification (Emergency stop circuit)
12	Timer	T	

Earth leakage breaker (ELB)

Model	Rated voltage ( ) is 400V	Sensitivity voltage
5.5kW	50AF/50A(50AF/40A)	30mA
7.5kW	60AF/60A(50AF/40A)	30mA

5. Explanation of operation

5-1) Alternate operation of the KF2 Type



Q_1 = Stop flow (10L/min)

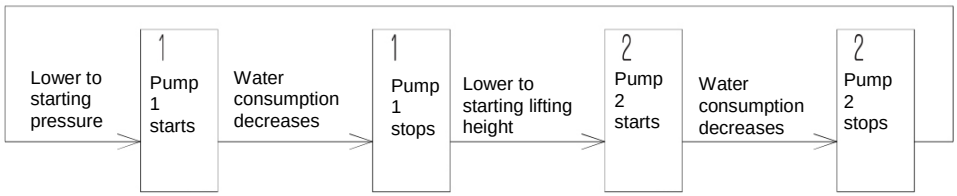
Q_2 = Maximum flow

P_1 = Set head (To be set on the panel inside)

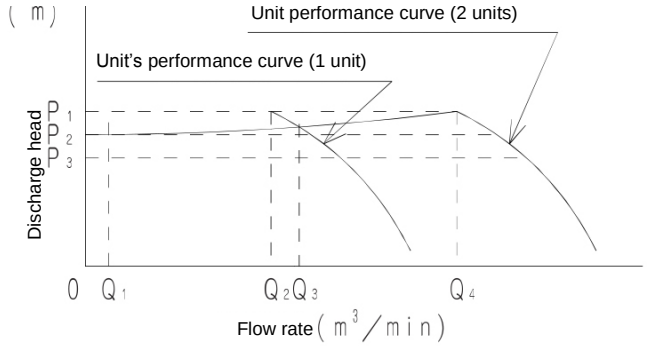
P_2 = Estimated terminal head (To be set on the panel inside)

P_3 = Starting head (P_2-4m)

(1) The pressure transmitter detects the pressure and the pump starts when water is used and the pressure decreases to P_3 with the pump not operating.
(2) If water consumption is between Q_1 and Q_2, the water supply continues at the estimated constant terminal pressure.
(3) If water consumption becomes Q_1 or lower, the flow sensor detects and the pump stops.
(4) Pump 1 and Pump 2 repeat (1) – (3) alternately.



5-2) Alternate /Parallel operation of the KF2 Type



Q_1 = Stop flow (10L/min)

Q_2 = Parallel off flow

Q_3 = Parallel flow

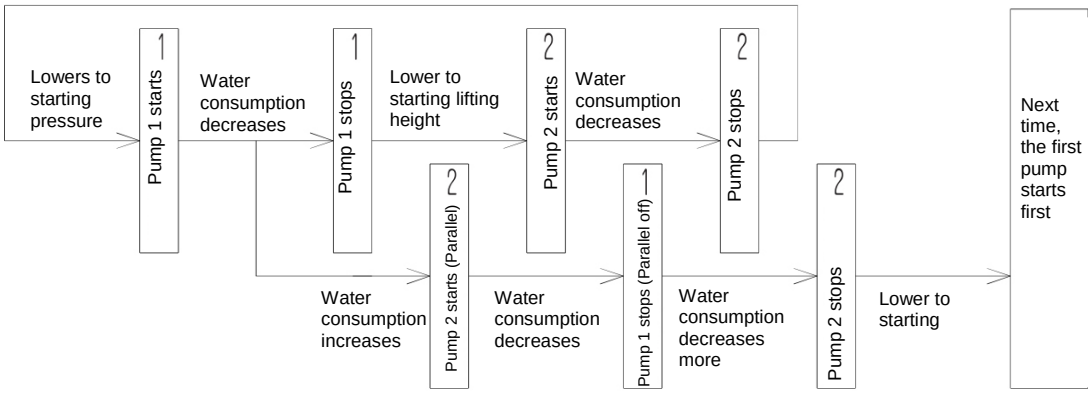
Q_4 = Maximum flow

P_1 = Set head (To be set on the panel inside)

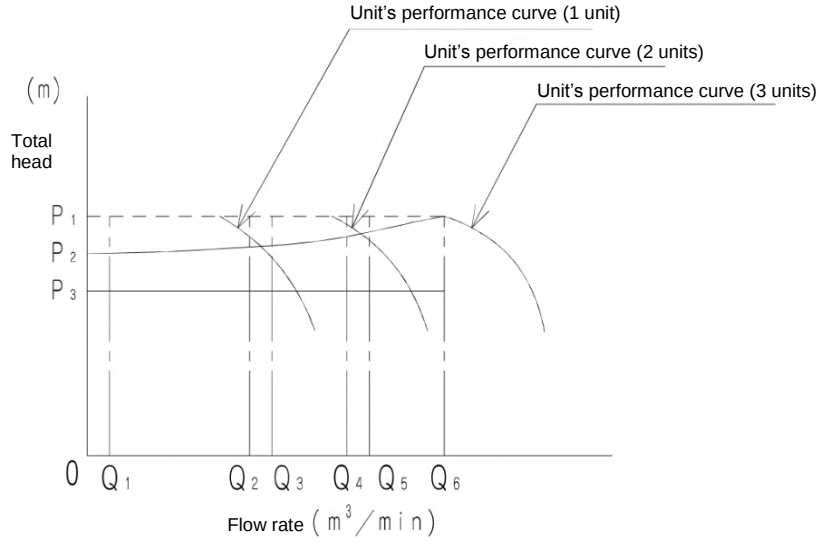
P_2 = Estimated terminal head (To be set on the panel inside)

P_3 = Starting head (P_2-4m)

(1) The pressure transmitter detects the pressure and the pump starts when water is used and the pressure decreases to P_3 with the pump not operating.
(2) If water consumption is between Q_1 and Q_2, the water supply continues at the estimated constant terminal pressure.
(3) If water consumption becomes Q_1 or lower, the flow sensor detects and the pump stops.
(4) If water consumption is lower than Q_3, the alternative operation repeats.
(5) If water consumption becomes Q_3 or higher and the pressure reduces to P_2 during single operation, the second pump starts and the parallel operation starts.
(6) If water consumption becomes Q_2 or lower during parallel operation, the first pump stops (parallel off), and single operation starts.
(7) If water consumption is lower than Q_3 , the alternative operation repeats. If water consumption is Q_3 or higher, (5) and (6) repeat.



5-3) 3 control rotary units KF2-T Type
Example: 3 rotary units operation



Constant discharge pressure

Constant estimated terminal pressure

Q_1 = Stop flow (0.01m^3/min)

Q_2, Q_4 = Flow to reduce the number of units

Q_3, Q_5 = Flow to increase the number of units

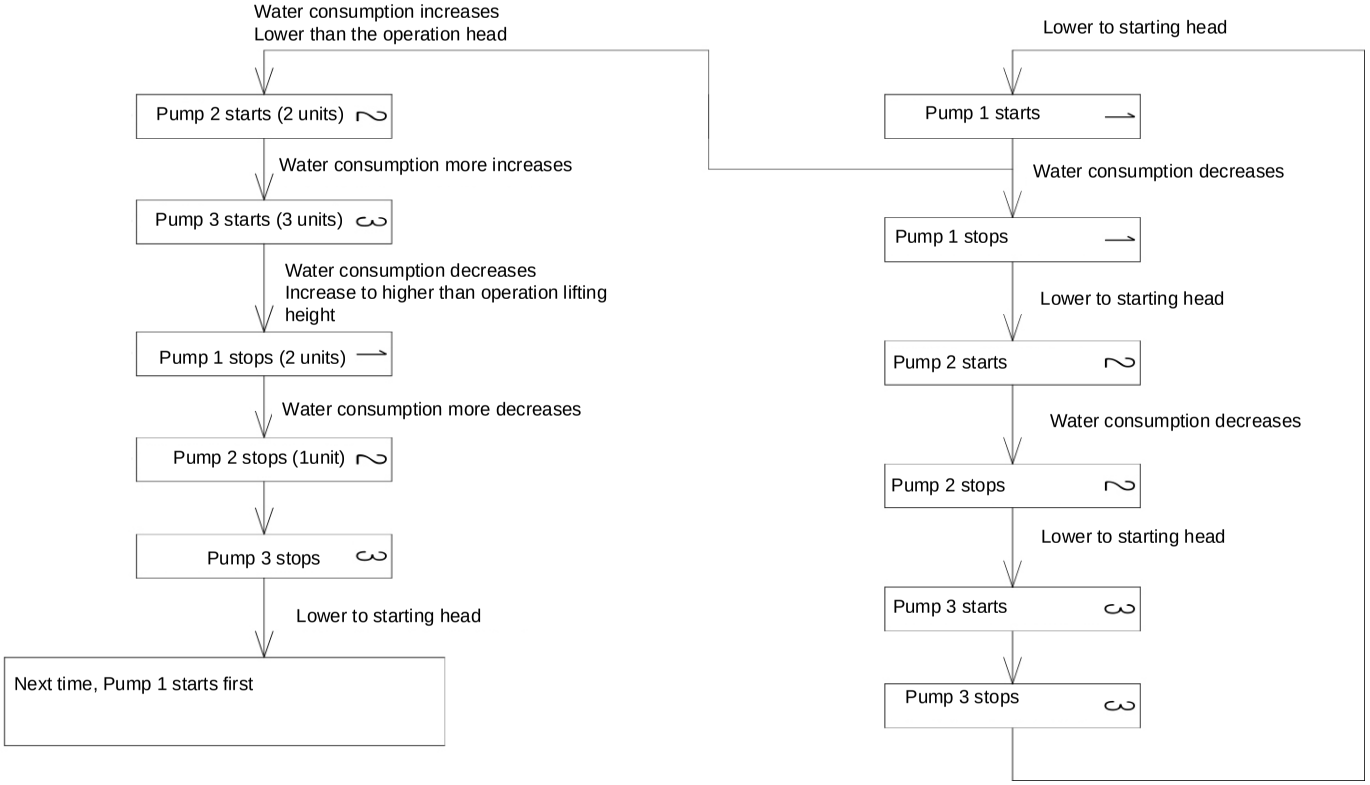
Q_6 = Maximum flow

P_1 = Set head

P_2 = Estimated terminal head

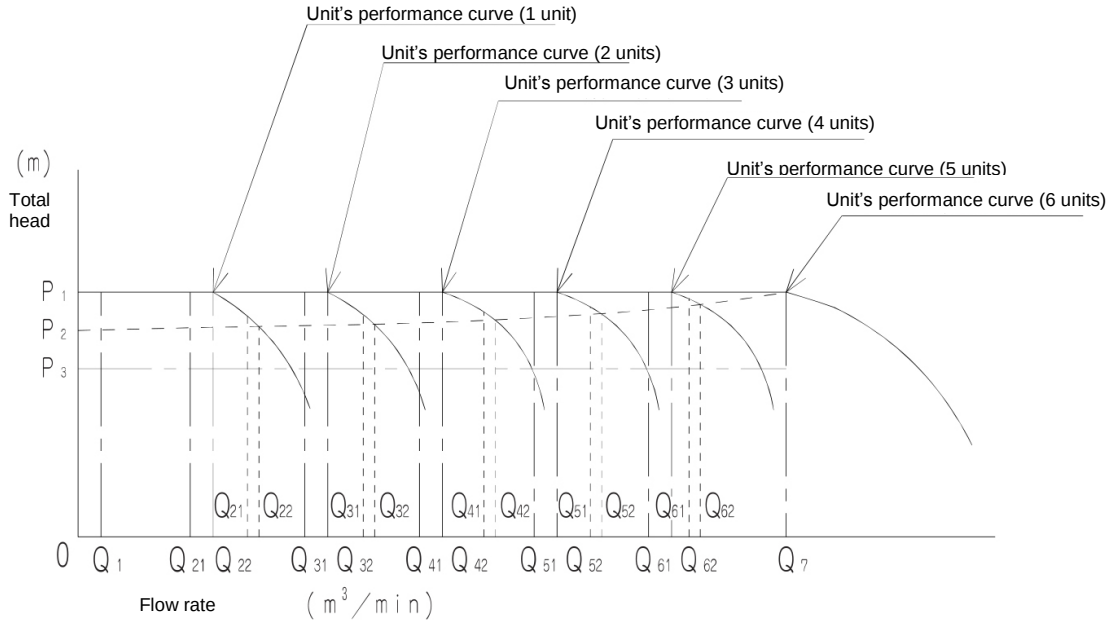
P_3 = Starting head (Constant discharge pressure: P_1-4m)
(Constant estimated terminal pressure: P_2-4m)

(1) The transmitter detects the pressure and the pump starts when water is used and the pressure decreases to P_3 with the pump not operating.
(2) When water consumption is between Q_1 and Q_3, the water supply continues at the estimated constant terminal pressure.
The constant discharge pressure/constant estimated terminal pressure is selected automatically depending on the input method of the set head.
(3) When the water consumption becomes Q_1 or lower, the flow sensor detects and the pump stops.
(4) In the case that water consumption is lower than Q_3, the rotary operation repeats.
(5) If water consumption increases to Q_3 or higher during single operation, the second pump starts and the 2-unit operation starts. If water consumption increases to Q_5 or higher, the third pump starts operating and the 3-unit operation starts.
(However, in the case of the variation 43 (operation by reducing the number of units), the maximum number of units is 2).
(6) If water consumption becomes Q_4 or lower during the 3-unit operation, the first pump stops and the 2-unit operation starts. If water consumption decreases to Q_2 or lower, the second pump stops and the single operation starts.
(7) If water consumption becomes Q_1 or lower, the flow sensor detects it and the pump stops.


Water consumption increases
Lower than the operation head
Pump 2 starts (2 units)
Water consumption more increases
Pump 3 starts (3 units)
Water consumption decreases
Increase to higher than operation lifting height
Pump 1 stops (2 units)
Water consumption more decreases
Pump 2 stops (1unit)
Pump 3 stops
Lower to starting head
Next time, Pump 1 starts first
Lower to starting head
Pump 1 starts
Water consumption decreases
Pump 1 stops
Lower to starting head
Pump 2 starts
Water consumption decreases
Pump 2 stops
Lower to starting head
Pump 3 starts
Pump 3 stops

5-4) Multiple rotary units, KF2-R Type

Example: 6 rotary unit operation



Constant discharge pressure

Q_1 = Stop flow (0.01m^3/min)

Q_{21}, Q_{31}, Q_{41}, Q_{51}, Q_{61} = Flow to reduce the number of units

Constant estimated terminal pressure

Q_{22}, Q_{32}, Q_{42}, Q_{52}, Q_{62} = Flow to increase the number of units

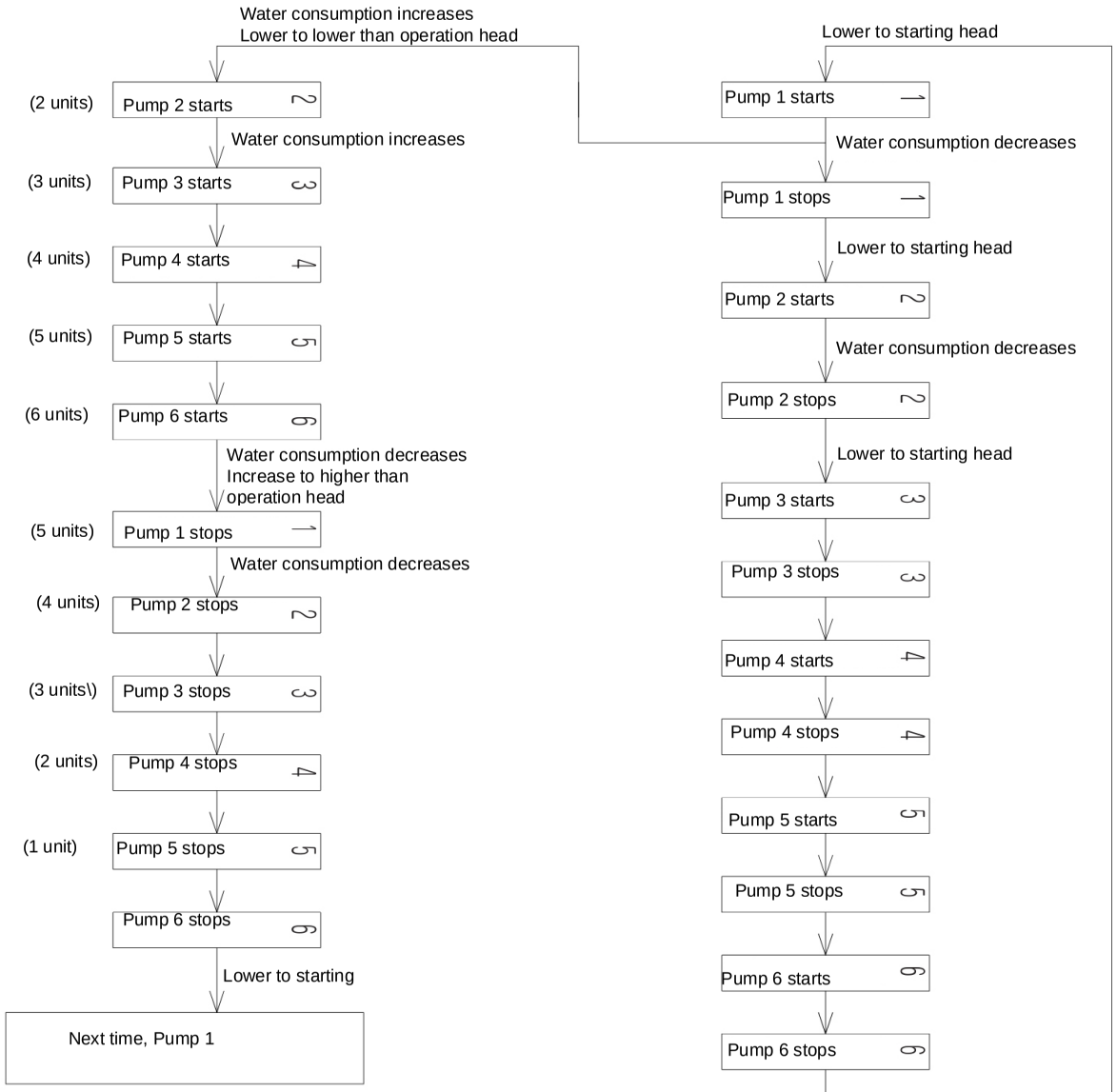
Q_7 = Maximum flow

P_1 = Set flow

P_2 = Estimated terminal head

P_3 = Starting lifting head (Constant discharge pressure: P_1-4m
(Constant estimated terminal pressure: P_2-4m

(1) The transmitter detects the pressure and the pump starts when water is used and the pressure decreases to P_3 with the pump not operating.
(2) When water consumption is between Q_1 and Q_{22}, the water supply continues at the estimated constant terminal pressure.
The constant discharge pressure/constant estimated terminal pressure is selected automatically depending on the input method of the set head.
(3) If water consumption becomes Q_1 or lower, the flow sensor detects it and the pump stops.
(4) In the case that water consumption is lower than Q_{22}, the rotary operation repeats.
(5) If water consumption increases to Q_{22} or higher during single operation, the second pump starts and the 2-unit operation starts. If water consumption increases to Q_{32}/ Q_{42}/ Q_{52}/ Q_{62}, the 3/4/5/6 -unit operations start accordingly.
However, in the case of variation 43 (operation by reducing the number of units), the maximum number of units is 5.
(6) If water consumption becomes Q_{61} or lower during the 6-unit operation, the first pump stops and the 5-unit operation starts. As water consumption decreases to Q_{51}/ Q_{41}/ Q_{31}/ Q_{21} or lower, the number of pump units is reduced, and the 4/3/2/single unit operations start accordingly.
(7) If water consumption becomes Q_1 or lower, the flow sensor detects it and the pump stops.


Water consumption increases
Lower to lower than operation head
(2 units)
Pump 2 starts 2
Water consumption increases
(3 units)
Pump 3 starts 3
(4 units)
Pump 4 starts 4
(5 units)
Pump 5 starts 5
(6 units)
Pump 6 starts 6
Water consumption decreases
Increase to higher than
operation head
(5 units)
Pump 1 stops 1
Water consumption decreases
(4 units)
Pump 2 stops 2
(3 units\)
Pump 3 stops 3
(2 units)
Pump 4 stops 4
(1 unit)
Pump 5 stops 5
Pump 6 stops 6
Lower to starting
Next time, Pump 1
Lower to starting head
Pump 1 starts 1
Water consumption decreases
Pump 1 stops 1
Lower to starting head
Pump 2 starts 2
Water consumption decreases
Pump 2 stops 2
Lower to starting head
Pump 3 starts 3
Pump 3 stops 3
Pump 4 starts 4
Pump 4 stops 4
Pump 5 starts 5
Pump 5 stops 5
Pump 6 starts 6
Pump 6 stops 6

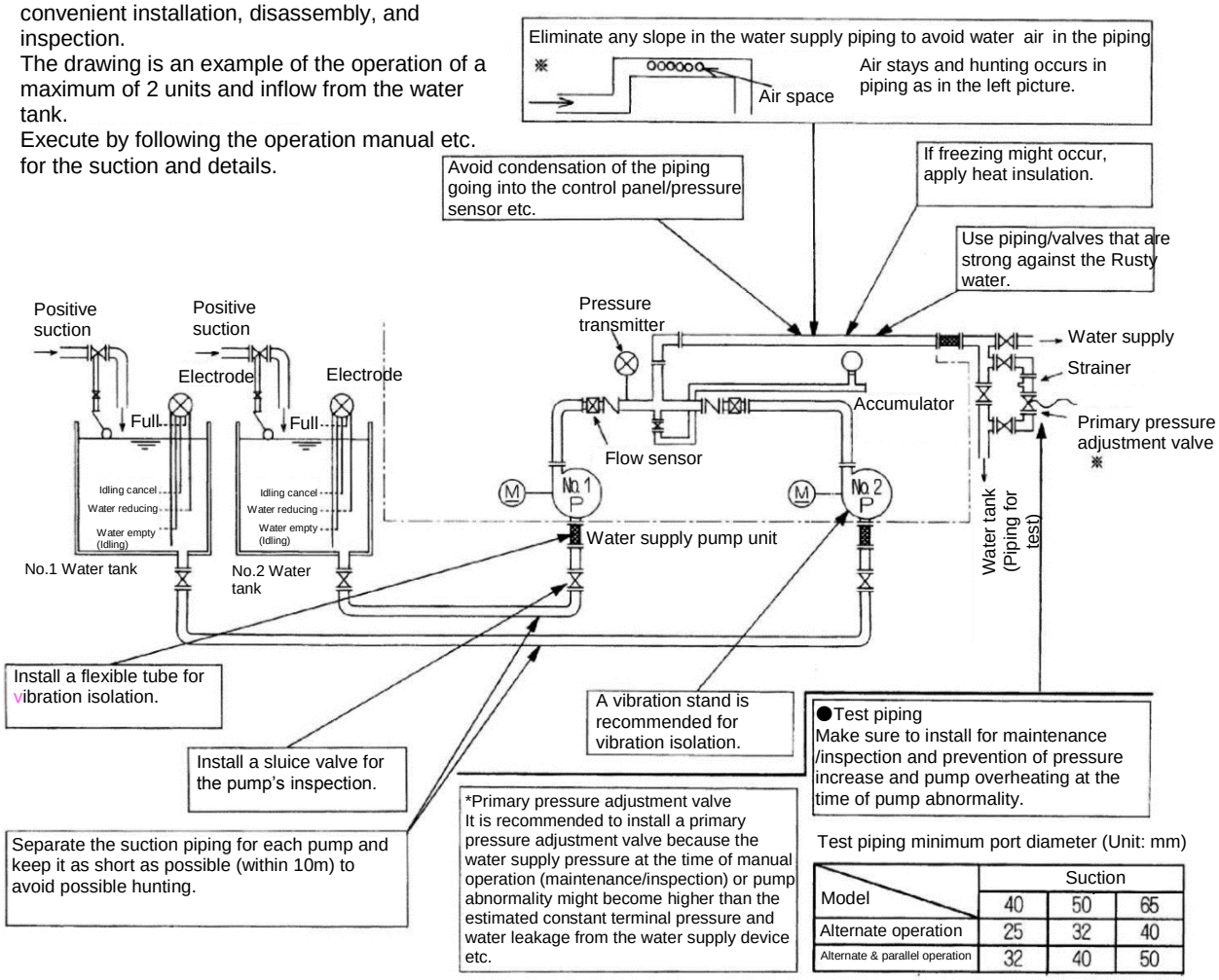
6. Precautions on execution/connection

6-1) Installation procedure

Select a location that is indoors and allows convenient installation, disassembly, and inspection.

The drawing is an example of the operation of a maximum of 2 units and inflow from the water tank.

Execute by following the operation manual etc. for the suction and details.



Test piping minimum port diameter (Unit: mm)

Model	Suction		
	40	50	65
Alternate operation	25	32	40
Alternate & parallel operation	32	40	50

6-2) Ambient conditions

(1) Ambient temperature (Within 0-40℃)

Note 1) If the temperature the pump room increases above the temperature range due to generation of heat by a boiler, heater or motor etc., a malfunction might occur, so in that case, make sure to install a ventilation fan.

Note 2) If the temperature might be 0℃ or lower in the winter season, the piping might freeze and be damaged, so make sure to apply insulation material.

Especially, apply to the pressure transmitter.

(2) Humidity (Within 90%)

Note 1) Because may electronic parts are used in the control panel, a failure might be caused if a water drop goes into the panel, so always ventilate inside the pump room.

(3) Altitude (1,000m or lower)

Because the inverter depends on atmospheric air for insulation and cooling, it becomes easier for insulation damage to occur and the insulation resistance becomes lower as the atmospheric pressure gets lower. In addition, if air becomes thin, chilling effect decreases, and temperature rises at working of the inverter. Consult us in the case of exceeding 1,000m.

(4) Dust

If using in a dusty place, malfunction or failure of the motor's bearing, control relay, or electronic parts might occur, so a measure such as a filter etc. is necessary. For a location close to a coast, consider to avoid salt water contamination.

Note 1) Be careful of a cloud of concrete dust and fine sand in a strong wind etc. during a working period.

6-3) Installation

1. Precautions regarding installation

⚠ Warning

●Implement the installation securely by following the operation manual. If the installation is not complete, electric shock, fire, or injury by falling might occur.

●In the case of hanging at the time of reloading, carrying in or installation, implement after checking the weight of the device and how to hang in the brochure, installation diagram, or operation manual. Do not hang a device whose weight is more than the rated load of the hanging fixture. If the hanging is not complete, injury by falling might occur.

(1) At the time of transfer/carrying in, hang at four points by fixing hanging shackles in the hanging holes (at four points) on the base as in <Drawing 1>. If hanging by the accumulator etc., damage might occur.

(2) Install horizontally, and fix securely with foundation bolts.
If the foundation is not horizontal or uneven, the base might twist and a failure occur.

2. Selection of the installation location

⚠ Cautions

●Do not install in a place lacking effective drainage and waterproofing. Serious damage might be caused by water leakage.

●Do not install in a place with high humidity such as a bathroom. If an electrical leakage occurs, an electric shock might be caused.

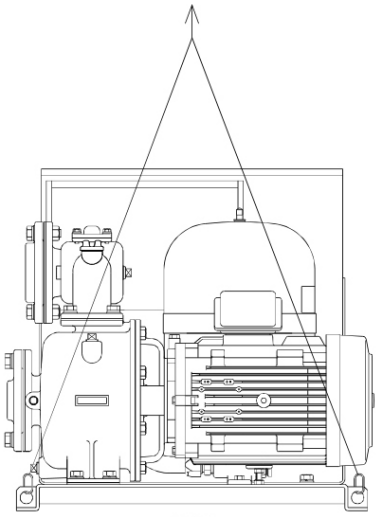
●Do not install in place where a hazard such as acid, alkali, solvent, paint or gas, including corrosive materials is generated, or a dusty place (i.e. a chemical factory). Electrical leakage or fire might occur.

(1) Install in a cool place without direct rainfall or sunshine that is convenient for disassembly/assembly.

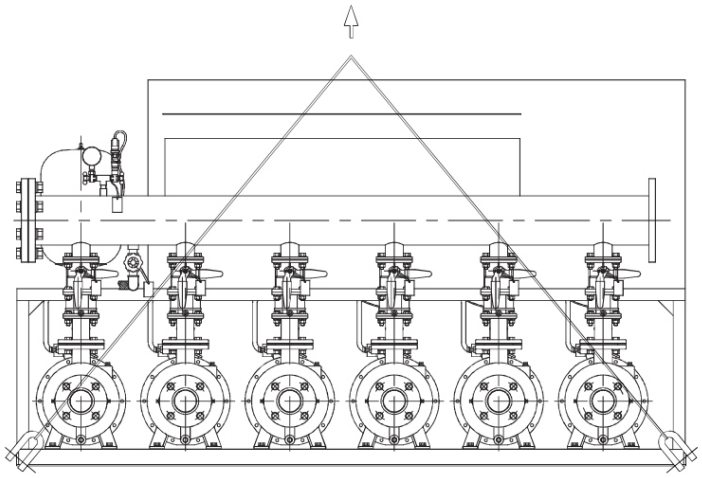
(2) In the case of installing in a place with direct rainfall or sunshine unavoidably, install a pump cover (special accessory).

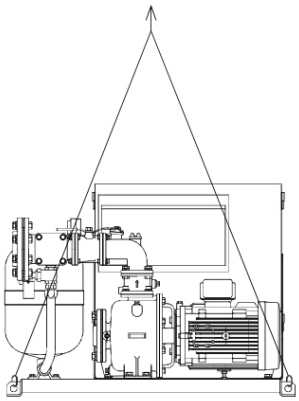
(3) Install in a place where the ambient temperature of the pump does not exceed 40℃ and not beyond 90%RH for the humidity.

<Drawing-1>

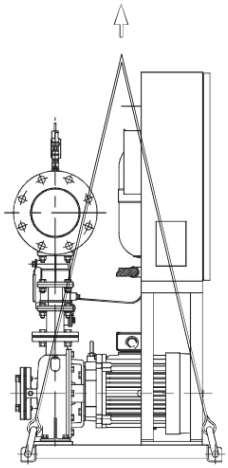


KF2





KF2-T



KF2-R

6-4) Piping: For the positive suction, refer to <Drawing-2>, for the suction, refer to <Drawing-3>.

⚠ Cautions

Do not let the pump suck foreign substance or sand. The lock of the impeller or mechanical seals might be damaged.

1) Suction piping

<Common>

① Fit suction piping to each pump, and do not form it at the half way point.

② Make the piping is as short as possible, and not bend as much as possible.

③ In the case that there is a worry of mixing by foreign substances or sand, install a strainer.

<Positive suction>

① Install a sluice valve for maintenance near the suction port.

<Negative suction>

① Make the tip of the suction piping is deeper than the pipe's diameter by two times or more, and separate it from the bottom by 30cm or more.

② Slope the suction piping to prevent dead air space.

③ Do not install a sluice valve in the suction piping.

④ Loosen the bypass valve of the check valve counter clockwise for about two rotations to apply positive pressure to each suction piping. Also, make sure there is no leakage from the foot valve.

2) Discharge piping

① Install a sluice valve for maintenance near the suction port.

② It is recommended to install maintenance test piping.

3) Common

① Install vibration-proof joints and piping supports to avoid a load on the piping of the pump directly.

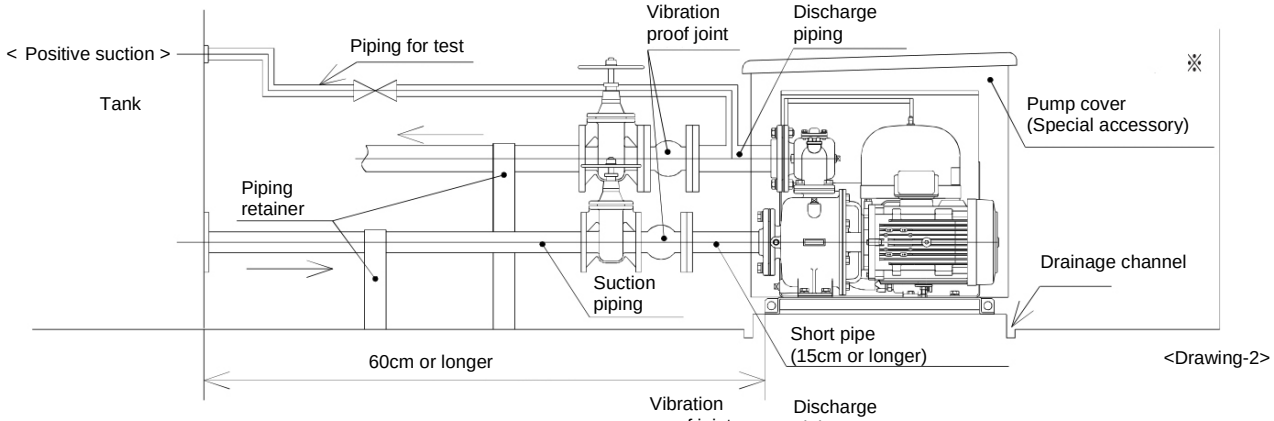
②To establish the drainage channel etc, to be able to do drainage enough even if it leaks water, and, consider the drainage.

③ To prevent freezing, apply heat insulating material around the piping. It is recommended to install a heater (special accessory) for the pump.

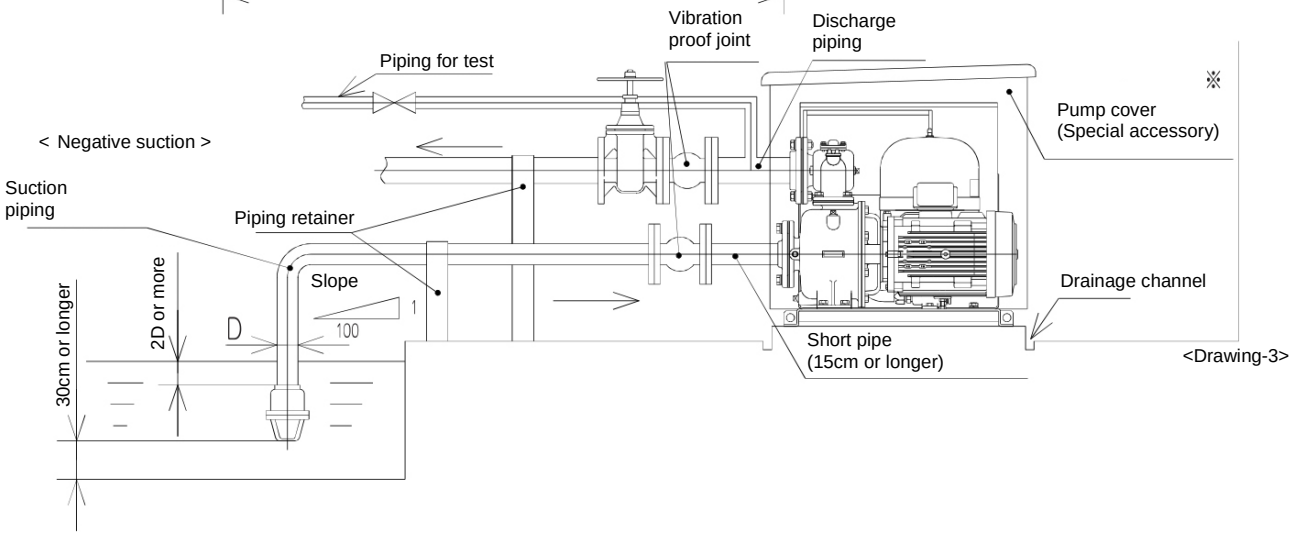
4) Precaution concerning installation of the pump cover

① In the case of installing a vibration-proof joint directly to the pump, it might contact the pump cover. In that case, install a short pipe between the pump and vibration-proof joint.

●KF2 Type



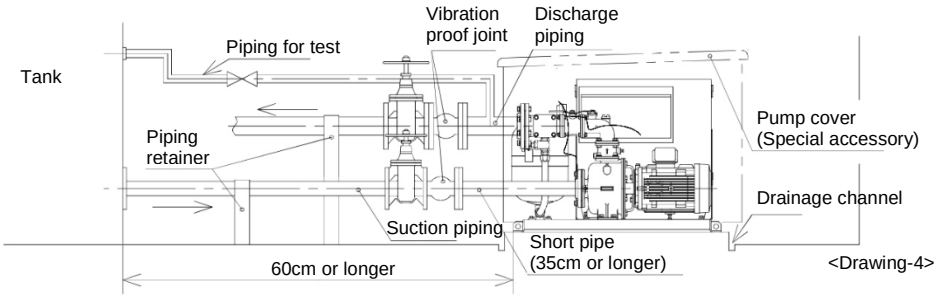
<Drawing-2>



<Drawing-3>

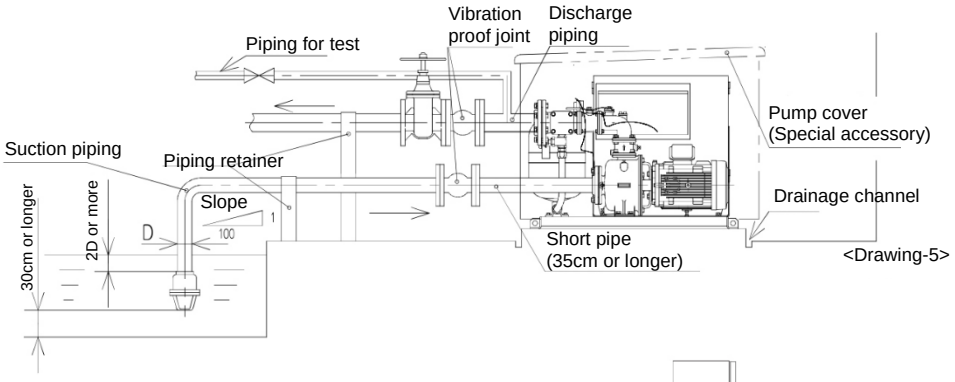
●KF2-T Type

< Positive suction >



<Drawing-4>

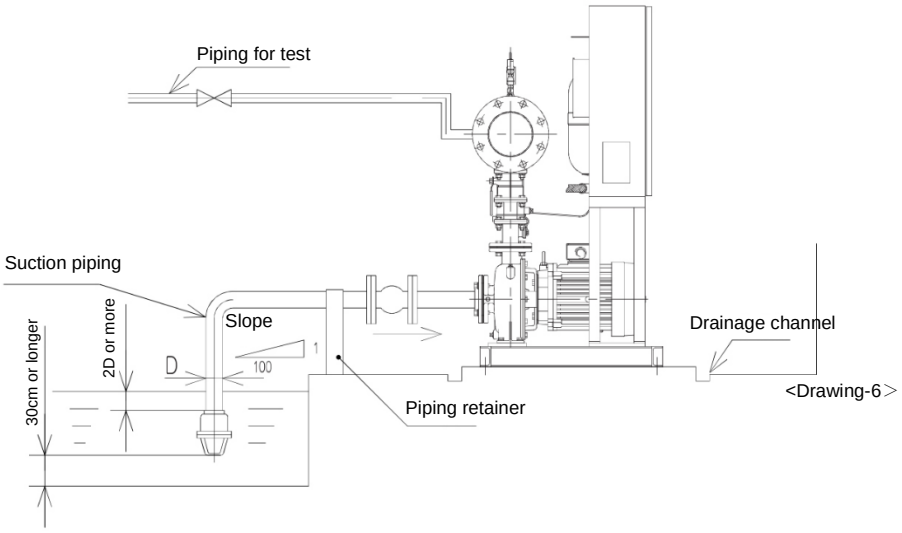
< Negative suction >



<Drawing-5>

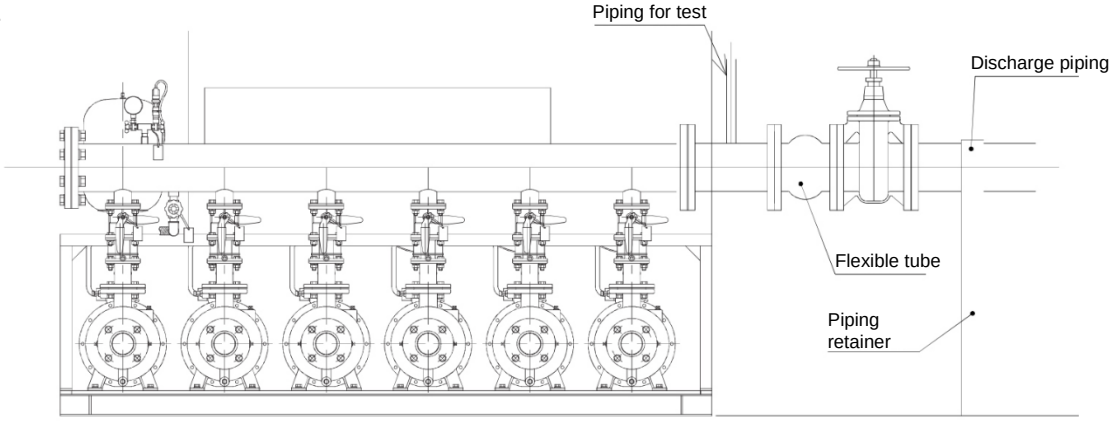
●KF2-R Type

< Negative suction >



<Drawing-6>

<Discharge>

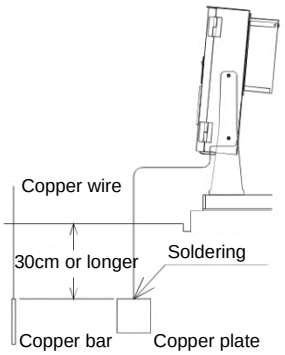


<Drawing-7>

⚠ Warnings

●Install grounding by grounding work of D type (Third type) securely. Install a dedicated earth leakage breaker. In the event of failure, electric shock or fire might occur.
●Make sure to implement grounding work before supplying electricity. Do no connect the grounding line to a gas pipe, water pipe, lightning rod or telephone grounding line. An electric shock might be caused if the grounding is defective.
●Execute electrical work safely and securely by following the electrical equipment's technical standard and interior wiring regulations. Electrical leakage or a failure might occur if wiring or a connection is defective.
●Do not install a phase-advanced condenser because it might cause trouble such abnormal heating etc.
●Consult us in the case of using with a generator. The control panel might be damaged.

1. Install an earth leakage breaker to the power source. Use an earth leakage breaker that supports higher harmonics and surge (rated sensitivity for electrical current 100mA). If using an earth leakage breaker that does not support the inverter load, a trip might be caused by electrical current leaking from the inverter or noise filter.
2. In case of a 3-phase model, connect the power line to the R S T terminals of the control panel. For the single-phase model, connect to the R S terminals. There is a grounding terminal in the control panel, so install grounding by grounding work of D type (Third type) securely. Connect grounding at the time of temporary wiring also. Solder copper plate (30cm×30cm or bigger) or copper bar (Thickness: 1cm or thicker, Length: 40cm or longer), and bury in a wet ground for 30cm or longer. In case of handling the grounding wire, turn the main power OFF.



<Drawing-8>

3. An inverter is used for this water supply unit, so the power factor cannot be improved by a phase-advanced condenser. Power factor improvement and higher harmonics control are implemented by the DC reactor. If inserting a condenser on the output side (motor) of the inverter, a large charge of electrical current to the condenser occurs, causing the inverter to trip. If repeating this, the element's destruction might be caused, so do not insert.

6-6) Connecting method

For the water supply unit, connection of the main parts (motor, pressure transmitter, flow sensor) has been implemented already, so implement only the connections below, as necessary.

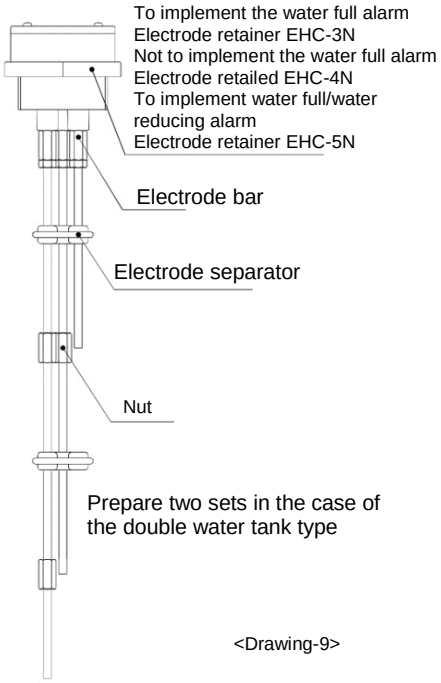
1. Liquid level control

⚠ Caution

Do not implement empty operation (operation without water in the tank), as the water in the pump becomes hot, and damage might occur. To prevent empty operation, fit the liquid level control unit in the tank.

To implement the liquid level control, the parts in <Drawing-9> are necessary. Buy separately by referring to the special accessory list.

(1) Fit the electrode depending on the water level in the tank. For operation of the level sensor, the water level gap changes by the effect of water quality, so be careful.
(2) The short-circuit line has been installed, so remove it.
For KF2 Type -0.75kW: With the short-circuit line between E1 and E3
For KF2 Type 1.1 kW-, KF2-T, KF2-R Type: With the short-circuit line between E11 and E3, E15 and E3, E11 and E12 (KF2-R)
(3) Connect by referring to the control panel development connection diagram <Drawings-10, 12, 14, 17>.
(4) In the case of using EHC-3 or EHC-4 (resistance built-in electrode retainer), remove the resistance inside.
(5) In the case of not implementing the water full alarm with the KF2-R Type, use the electrode retainer EHC-4N, and if not implementing the water full alarm and water reducing alarm with the KF2-R Type, use the electrode retainer EHC-3N.

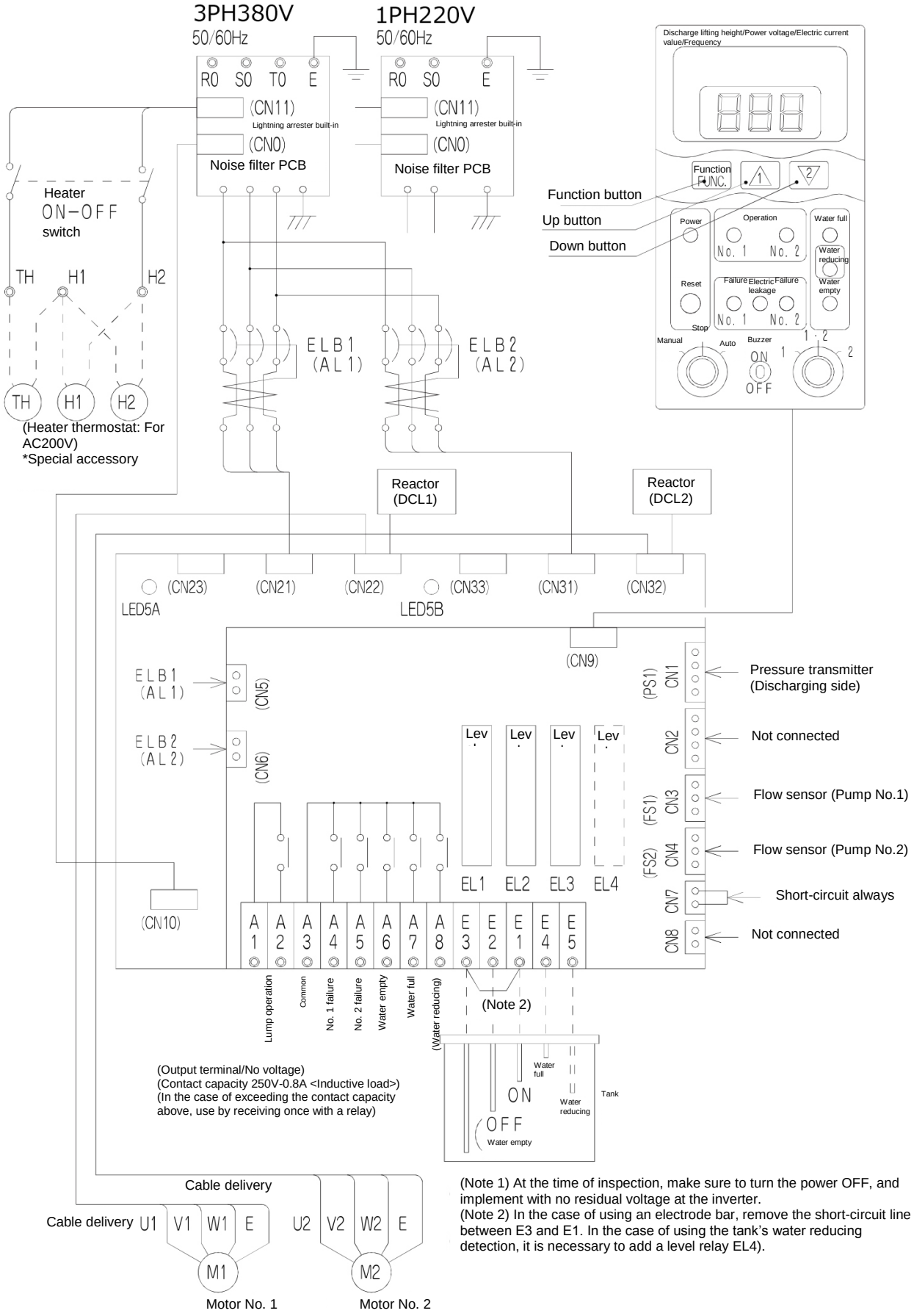


<Drawing-9>

2. Refer to the external signal: <Drawings-10, 12>.

This is the non-voltage output terminal for the external signal to connect to the monitor panel etc. Connect by referring to the terminal connection diagram.

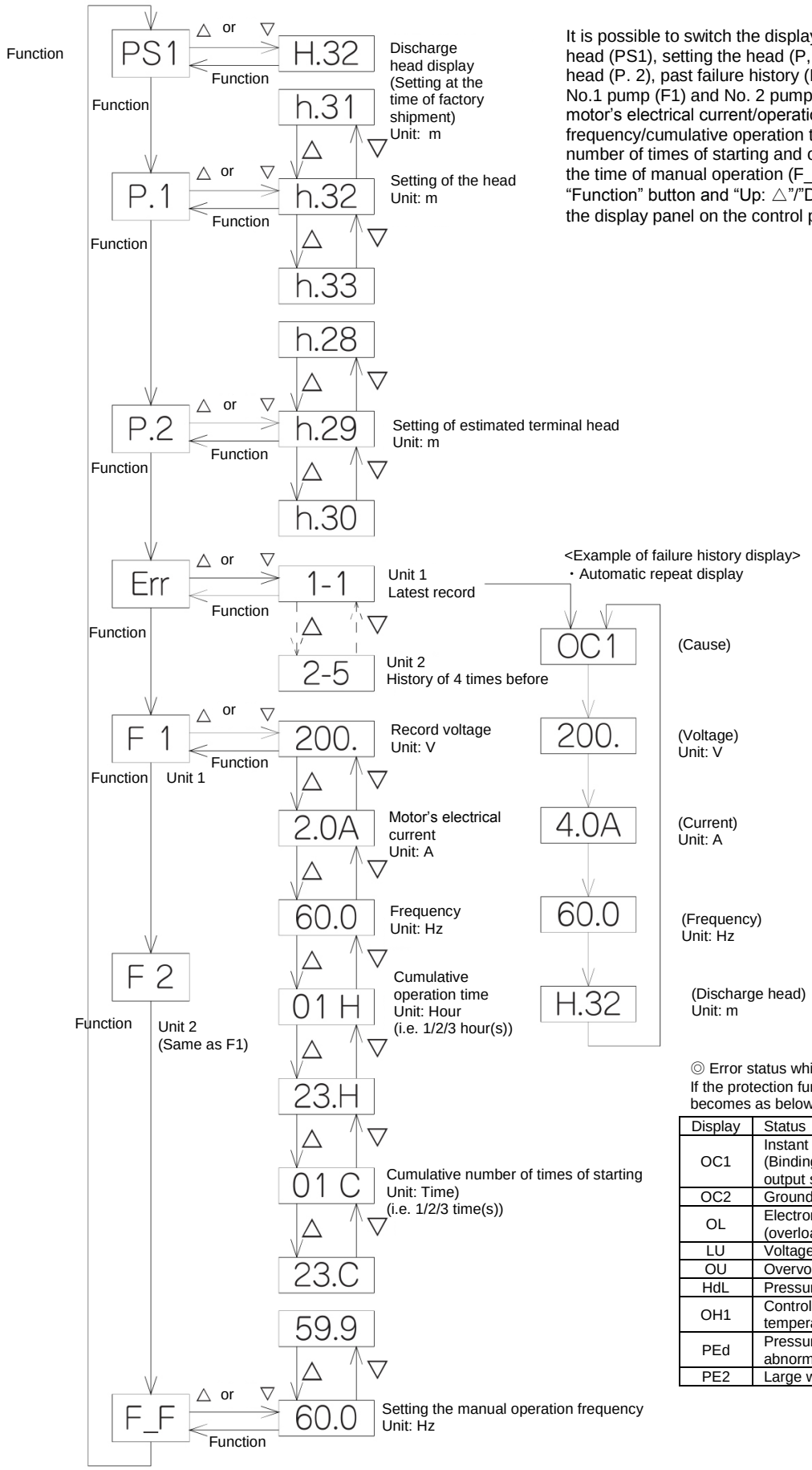
●Development connection diagram of the control panel for KF2 Type -0.75kW



(Note 1) At the time of inspection, make sure to turn the power OFF, and implement with no residual voltage at the inverter.
(Note 2) In the case of using an electrode bar, remove the short-circuit line between E3 and E1. In the case of using the tank's water reducing detection, it is necessary to add a level relay EL4).

<Drawing-10>

●Operation method of display panel on control panel for KF2 Type -0.75kW

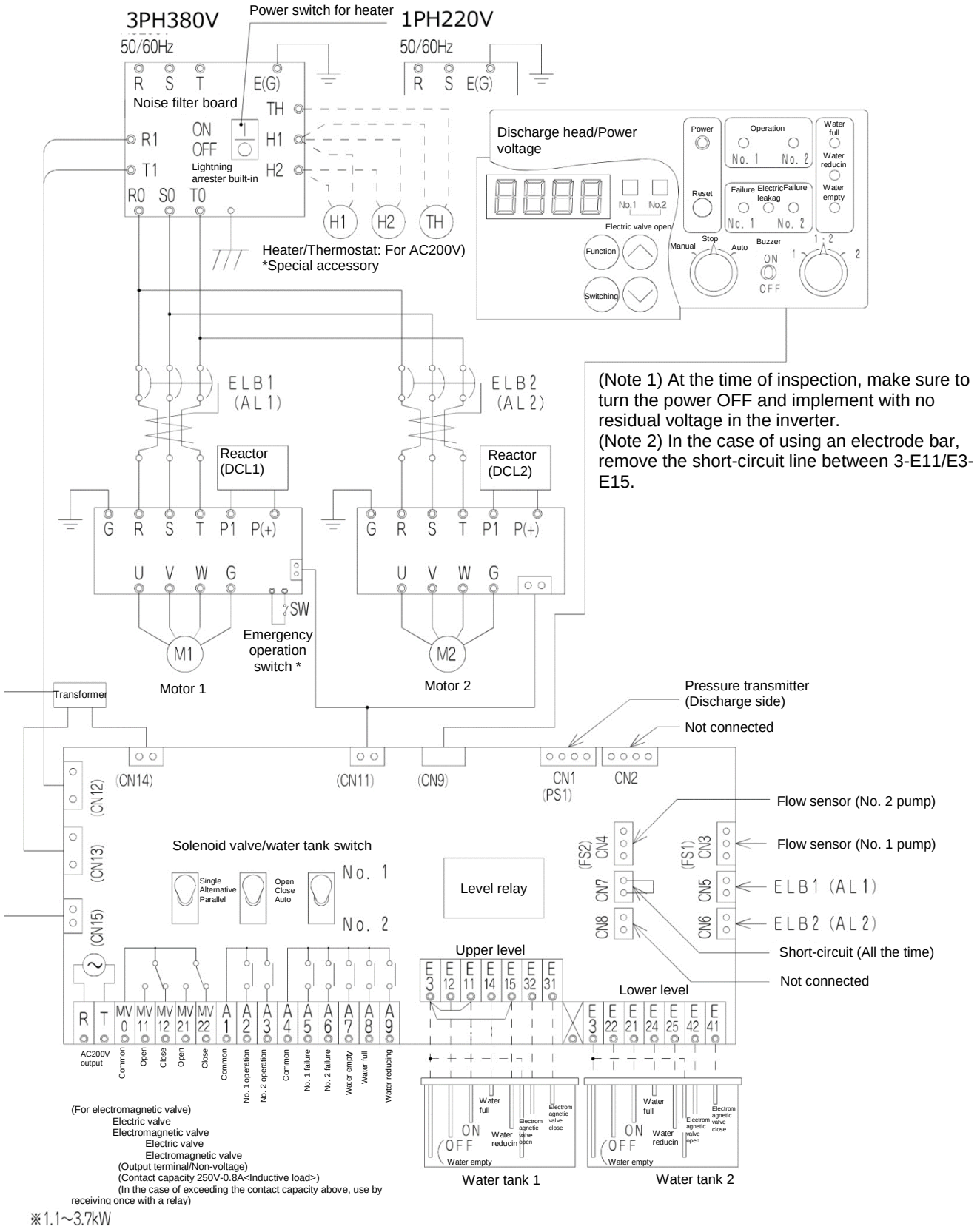


It is possible to switch the display for the discharge head (PS1), setting the head (P, 1)/estimated terminal head (P. 2), past failure history (Err), power voltage of No.1 pump (F1) and No. 2 pump (F2), display of the motor's electrical current/operation frequency/cumulative operation time/cumulative number of times of starting and operation frequency at the time of manual operation (F_F) by pushing the "Function" button and "Up: △"/"Down: ▽" buttons on the display panel on the control panel.

◎ Error status while operating
If the protection function works, the display becomes as below.

Display	Status
OC1	Instant overcurrent protection (Binding, short-circuit on the output side)
OC2	Ground at the time of start
OL	Electronic thermal operation (overload)
LU	Voltage shortage protection
OU	Overvoltage protection
HdL	Pressure reduction
OH1	Control panel/Abnormal temperature increase protection
PEd	Pressure transmitter abnormality
PE2	Large water volume operation

48●KF2 Type 1.1kW or up: Development connection diagram for the control panel



(Note 1) At the time of inspection, make sure to turn the power OFF and implement with no residual voltage in the inverter.
(Note 2) In the case of using an electrode bar, remove the short-circuit line between 3-E11/E3-E15.

<Drawing 12>

49●KF2 Type 1.1kW or up: Operation method of the display panel on the control panel

(1) Inverter section display panel

・How to switch the display of the electrical current/frequency

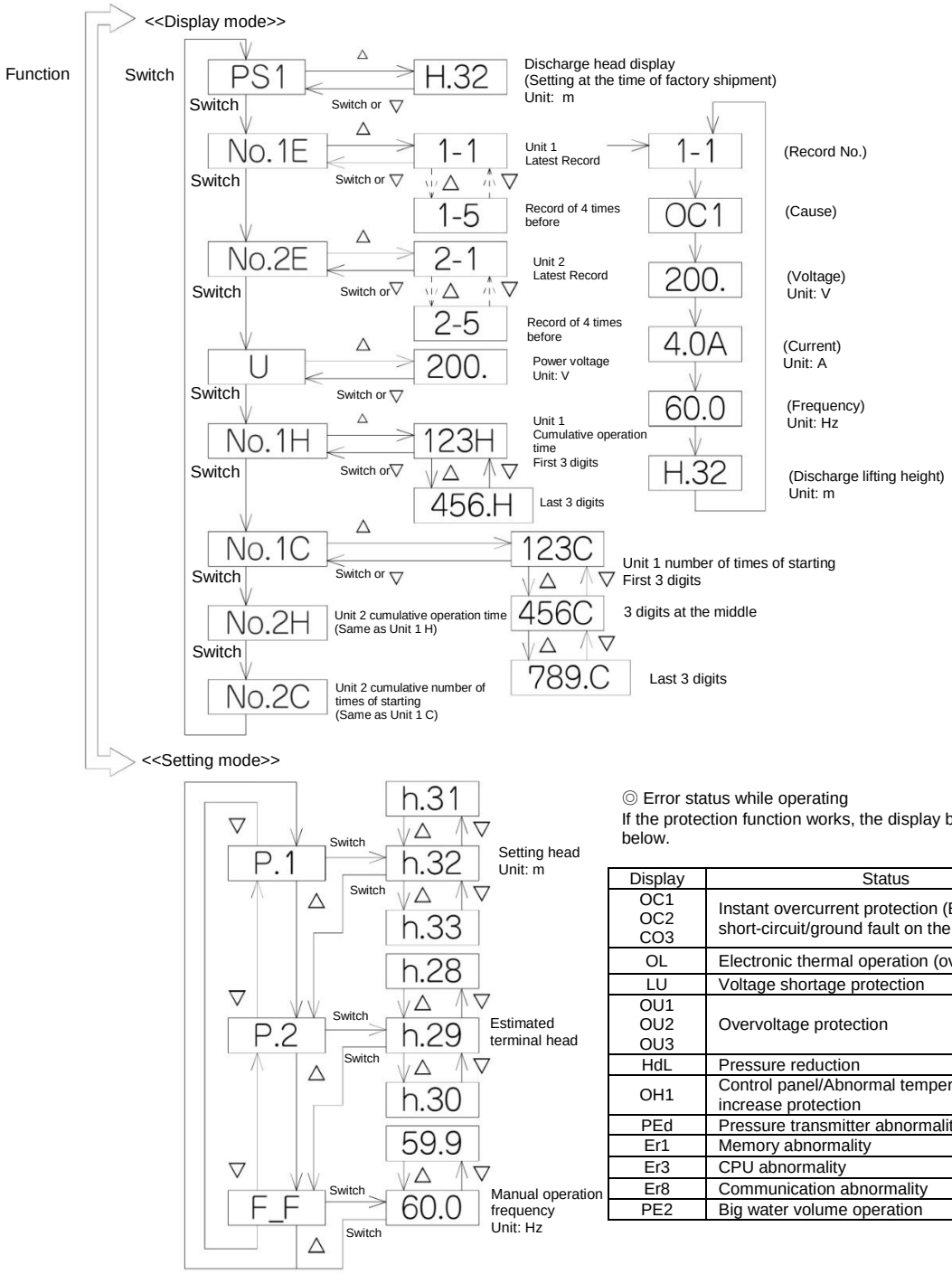
By pushing the key at the lower left of each inverter display panel, the electrical current or frequency is displayed alternately.

(“A” at the end: Display of the electrical current)

(2) Display panel on the control board section

・It is possible to switch each display/setting mentioned in <Drawing-13> on the display panel on the control board section.

・It is possible to switch <<Display mode>> and <<Setting mode>> with the “Function button”.



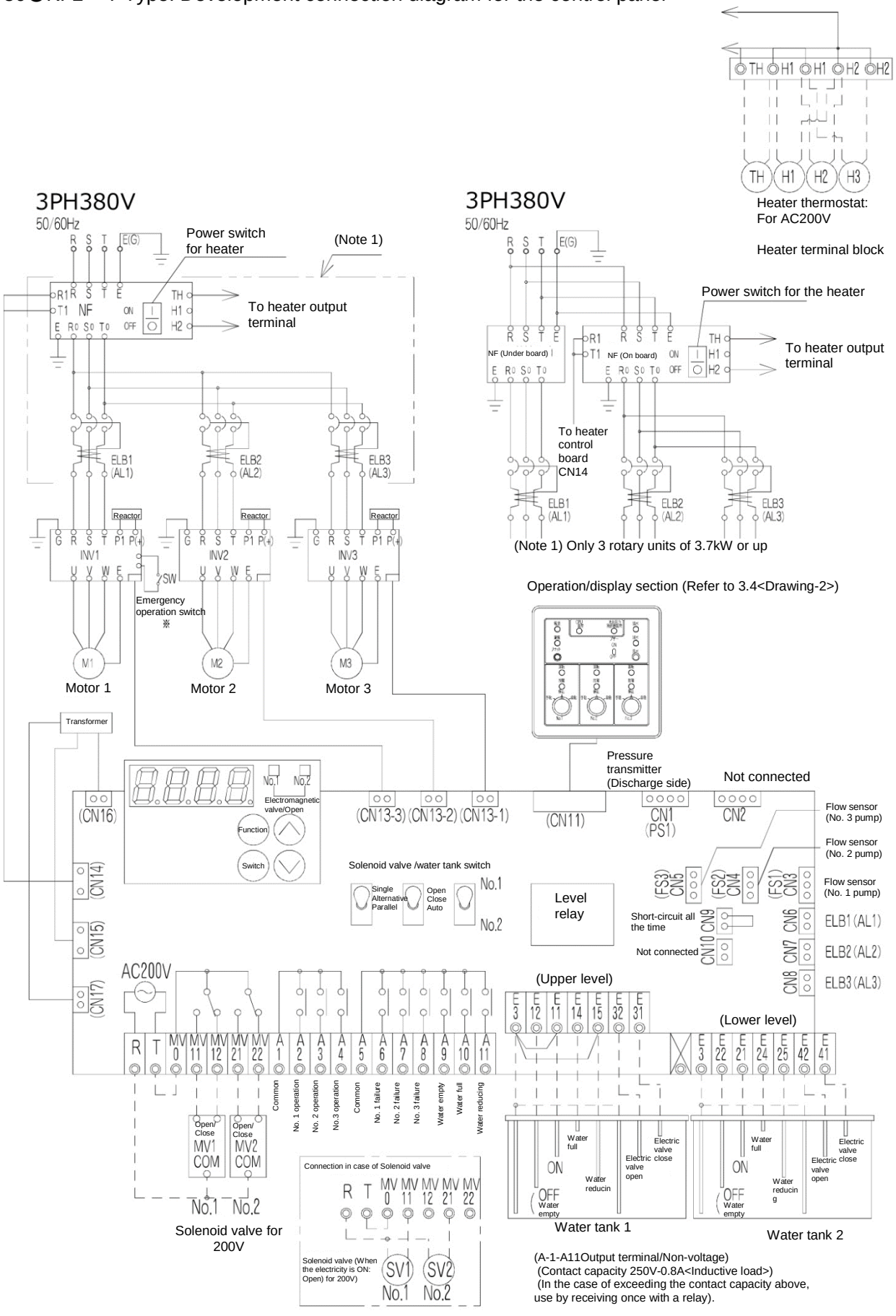
◎ Error status while operating

If the protection function works, the display becomes as below.

Display	Status
OC1 OC2 CO3	Instant overcurrent protection (Binding, short-circuit/ground fault on the output side)
OL	Electronic thermal operation (overload)
LU	Voltage shortage protection
OU1 OU2 OU3	Overvoltage protection
HdL	Pressure reduction
OH1	Control panel/Abnormal temperature increase protection
PEd	Pressure transmitter abnormality
Er1	Memory abnormality
Er3	CPU abnormality
Er8	Communication abnormality
PE2	Big water volume operation

<Drawing-13>

50●KF2 – T Type: Development connection diagram for the control panel



※1.5~3.7kW

<Drawing-14>

51●KF2-T Type: Operation method of the display panel on the control panel

(1) Inverter section display panel

・How to switch the display of the electrical current/frequency

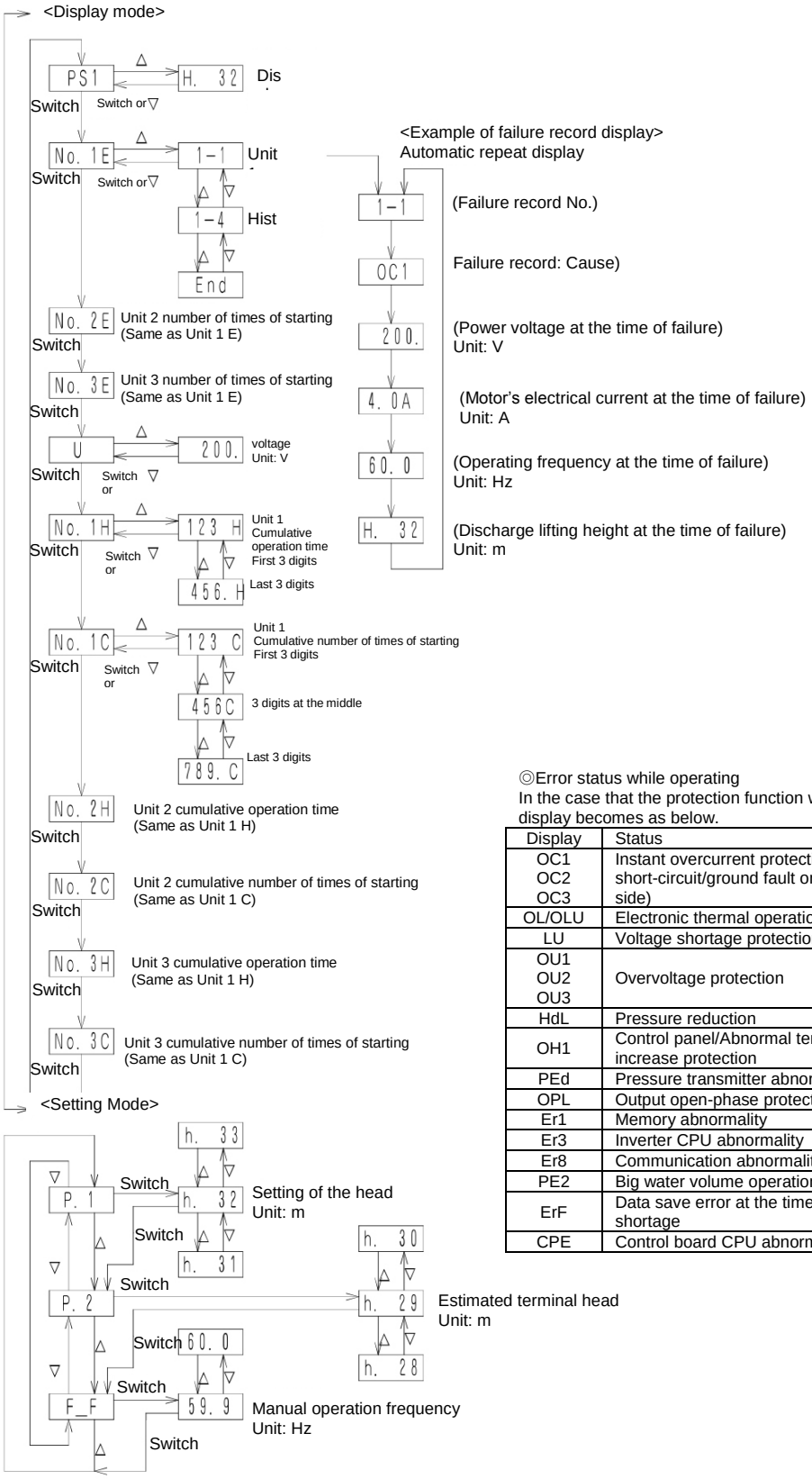
By pushing the key at the lower left of each inverter display panel, the electrical current/power/voltage/frequency is displayed alternately.

("A" at the end: Electrical current [A], "P": Electricity consumption [kW], "V": Output voltage [V], None: Output frequency [Hz])

(2) Display panel on the control board section

・It is possible to switch each display/setting mentioned in <Drawing-15> on the display panel on the control board section.

・It is possible to switch <<Display mode>> and <<Setting mode>> with the "Function button".



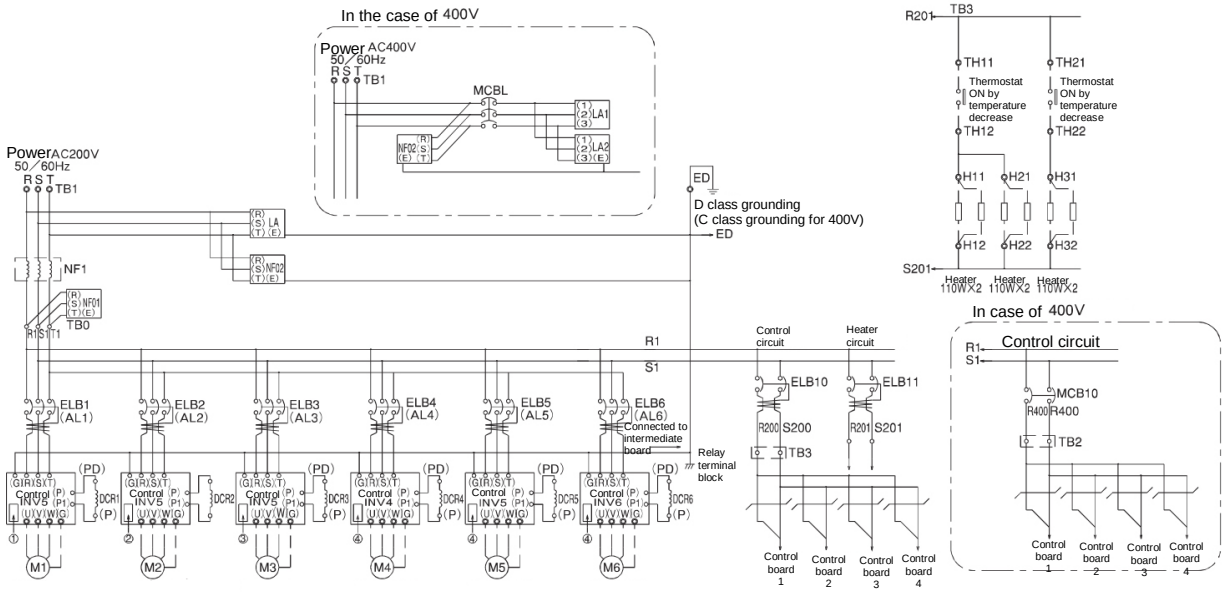
◎Error status while operating

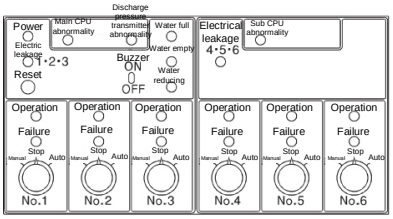
In the case that the protection function works, the display becomes as below.

Display	Status
OC1 OC2 OC3	Instant overcurrent protection (Binding, short-circuit/ground fault on the output side)
OL/OLU	Electronic thermal operation (overload)
LU	Voltage shortage protection
OU1 OU2 OU3	Overvoltage protection
HdL	Pressure reduction
OH1	Control panel/Abnormal temperature increase protection
PEd	Pressure transmitter abnormality
OPL	Output open-phase protection
Er1	Memory abnormality
Er3	Inverter CPU abnormality
Er8	Communication abnormality
PE2	Big water volume operation
ErF	Data save error at the time of voltage shortage
CPE	Control board CPU abnormality

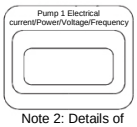
<Drawing-15>

●KF2-R Type: Development connection diagram for the control panel

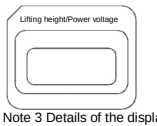




Details of display section

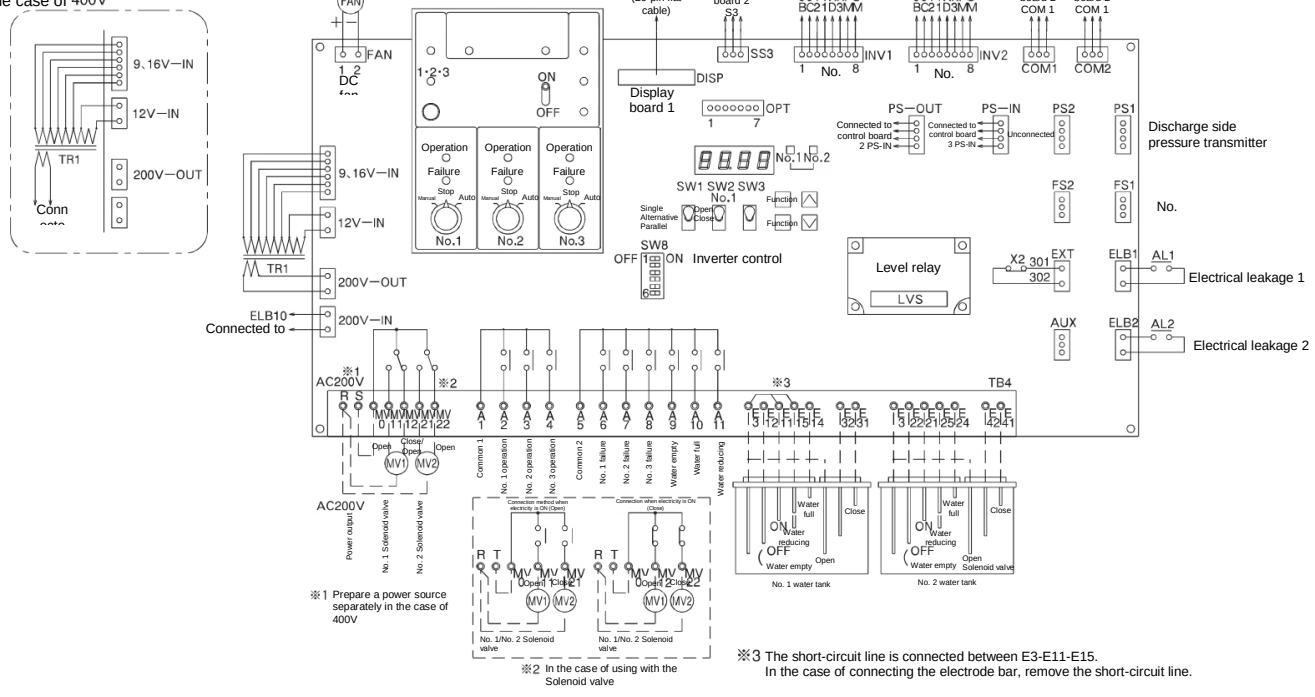


Note 2: Details of the display section



Note 3 Details of the display section

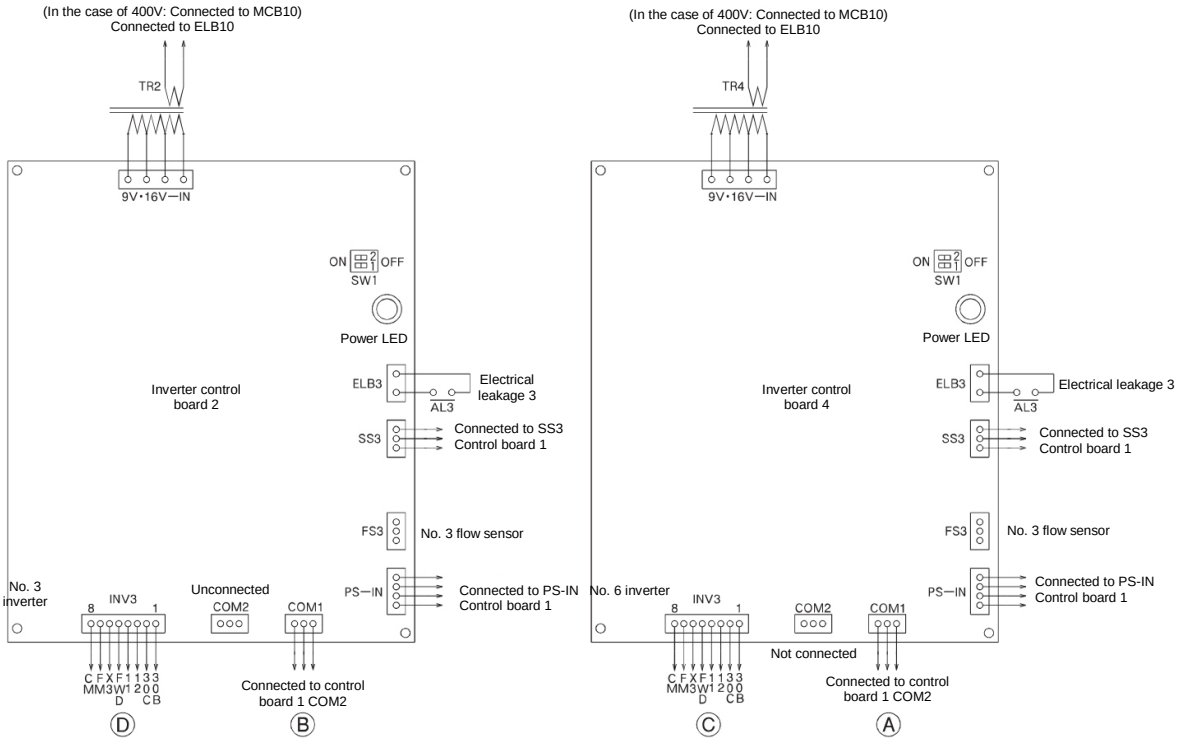
In the case of 400V

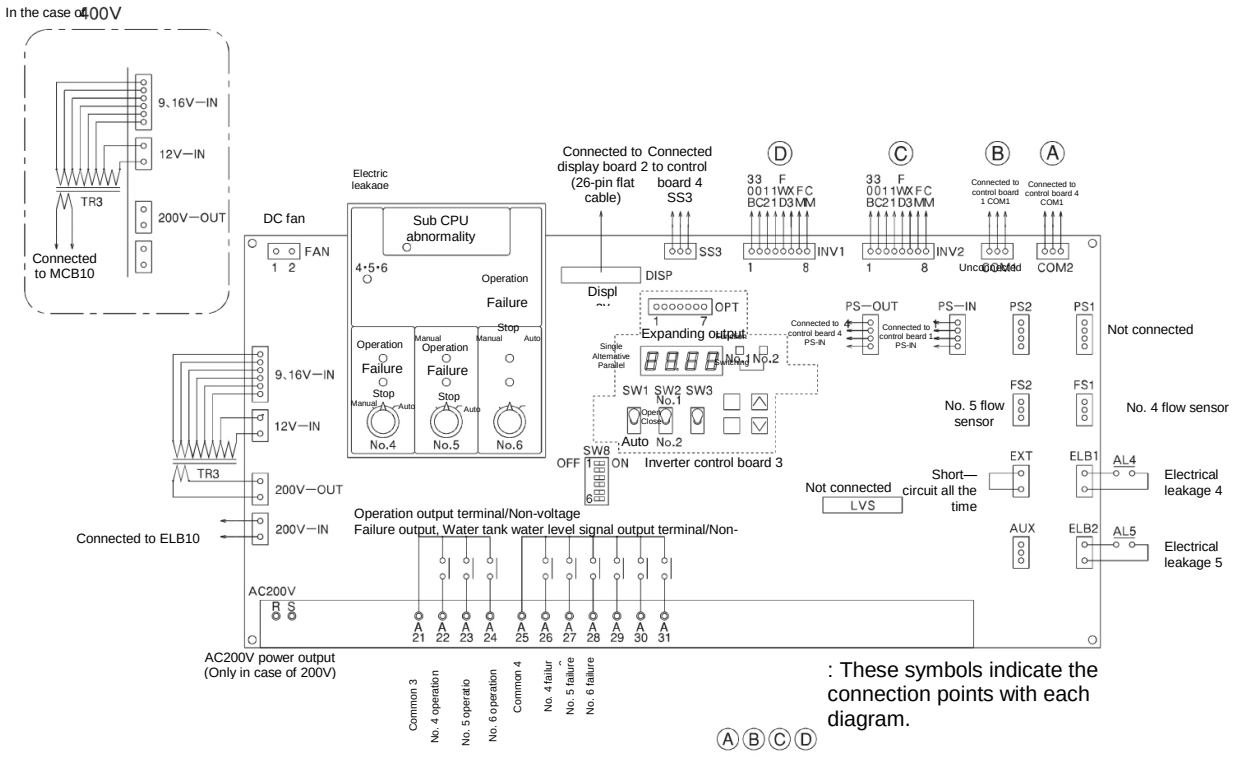


※1 Prepare a power source separately in the case of 400V

※2 In the case of using with the Solenoid valve

※3 The short-circuit line is connected between E3-E11-E15.
In the case of connecting the electrode bar, remove the short-circuit line.


(In the case of 400V: Connected to MCB10)
Connected to ELB10
TR2
9V•16V—IN
ON
SW1
OFF
Power LED
Inverter control board 2
ELB3
Electrical leakage 3
AL3
SS3
Connected to SS3 Control board 1
FS3
No. 3 flow sensor
No. 3 inverter
INV3
Unconnected
COM2
COM1
PS—IN
Connected to PS-IN Control board 1
Connected to control board 1 COM2
Ⓓ
Ⓑ
(In the case of 400V: Connected to MCB10)
Connected to ELB10
TR4
Inverter control board 4
No. 6 inverter
Not connected
Connected to control board 1 COM2
Ⓒ
Ⓐ


In the case of 400V
9、16V—IN
12V—IN
200V—OUT
TR3
Connected to MCB10
DC fan
FAN
Electric leakage
Sub CPU abnormality
Operation Failure Stop
No.4
No.5
No.6
Connected to display board 2 (26-pin flat cable)
Connected to control board 4 SS3
SS3
DISP
INV1
INV2
Connected to control board 1 COM1
Connected to control board 4 COM1
COM2
OPT
Expanding output
PS—OUT
PS—IN
PS2
PS1
Not connected
SW1 SW2 SW3
No.1
No.2
Auto
SW8
Inverter control board 3
FS2
FS1
No. 5 flow sensor
No. 4 flow sensor
EXT
ELB1
AL4
Electrical leakage 4
Not connected
Short—circuit all the time
LVS
AUX
ELB2
AL5
Electrical leakage 5
Connected to ELB10
Operation output terminal/Non-voltage
Failure output, Water tank water level signal output terminal/Non-
AC200V
AC200V power output (Only in case of 200V)
Common 3
No. 4 operation
No. 5 operatio
No. 6 operation
Common 4
No. 4 failur
No. 5 failure
No. 6 failure
: These symbols indicate the connection points with each diagram.
Ⓐ Ⓑ Ⓒ Ⓓ

●KF2-R Type: Operation method of the display panel on the control panel

(1) Inverter section display panel

・How to switch the display of electrical current/frequency

By pushing the key at the lower left of each inverter display panel, the electrical current/power/voltage/frequency is displayed alternate.

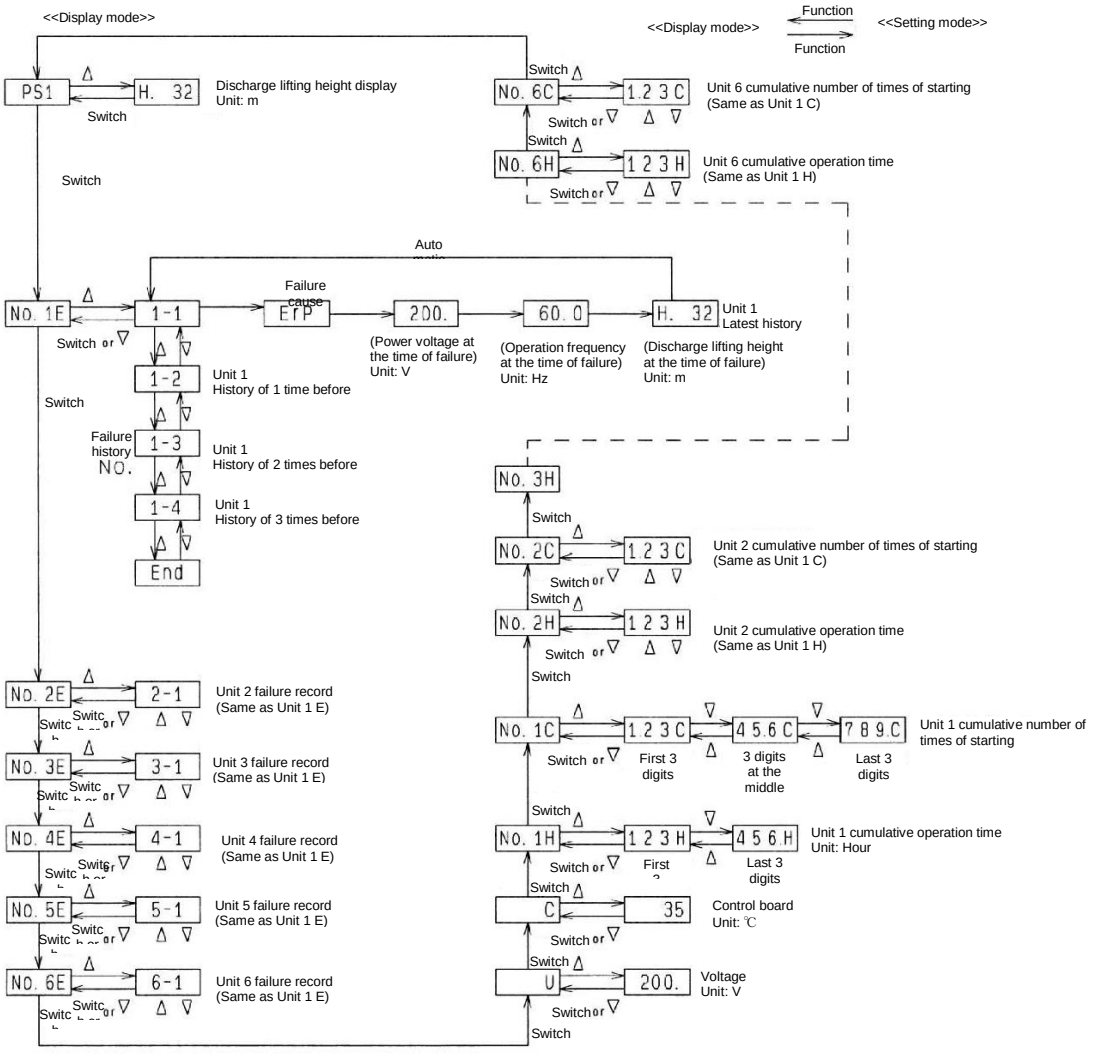
5.5kW～ identifies the items displayed by the LED display and the end of the symbol

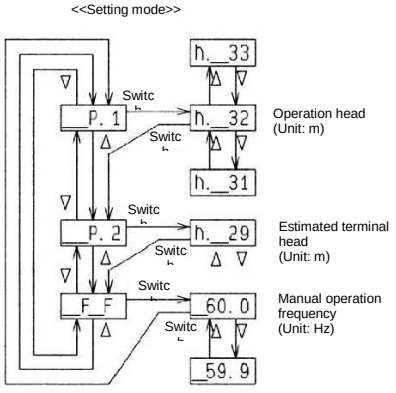
(“A” at the end: Electrical current [A], “P”: Electricity consumption [kW], “V”: Output voltage [V], None: Output frequency [Hz])

(2) Display panel on the control board section

・It is possible to switch each display/setting mentioned in <Drawing-11> on the display panel on the control board section.

・It is possible to switch <<Display mode>> and <<Setting mode>> with the “Function button”.





◎ Error status during operation

・In the case that the protection function operates, the display shall be as below.

[Items displayed on the control board]

Display	Content
FOP	External interruption
PEd	Pressure transmitter abnormality
HdL	Pressure reduction
CPE	Control panel abnormality
ErP	Inverter abnormality (Only history)
PE2	Big water volume operation (Only history)
OH2	Abnormal temperature increase

[Items displayed on the inverter]

Display	Content
OC1~3	Instant overcurrent protection
OU1~3	Overcurrent protection
OL1/OLU	Electronic thermal operation
OH1	Abnormal temperature increase
Lin	Input open-phase
OPL	Output open-phase
Er1	Memory abnormality
Er2	Communication abnormality (Inverter operating section)
Er3	CPU abnormality
Er8/ErP	Communication abnormality (control board section)
ErF	Data save error at the time of voltage shortage
ErH	Communication board connection abnormality

6-7) Operation

⚠ Warnings

●In the case of connecting or disconnecting wiring, shut the power source OFF, and confirm no electricity supply. Electric shock might occur.
●After turning the power ON, do not leave the door of the control panel open or touch the charging section. Do not operate the operation switch etc. with a wet hand. Electric shock, electrical leakage, or a fire might occur.

⚠ Cautions

●Do not use with any voltage level other than the rated voltage. Fire or electric shock might occur.
●Do not implement empty operation (operation without water in the tank) or TEFC manual operation (status without positive suction/outflow of water in the pump). The pump gets hot, and burn or failure might occur.
●Do not put a finger or stick into the opening section of the motor while operating. Electric shock or injury might occur.
●Do not touch the motor or control panel while operating or right after operating because it might be hot. A burn could occur.
●In the case of changing a setting value of the control device, contact the unit's supplier or the service provider designated by our Company. If you change a setting value yourself, failure of the device or water leakage may occur.
●Shut the power source OFF when not using for a long time. Electric shock, electricity leakage, or fire may occur due to insulation degradation.
●Do not cover the pump or control panel with a blanket or cloth or put an object on it. Electricity leakage, fire, or injury may occur due to insulation degradation.
●Confirm that there is water inside the pump. The heater might disconnect, or a fire might occur.

1) Before starting operation
(1) Check all connections
① Confirm that the wiring is implemented correctly and the terminal screws are securely tightened
② Check the power source
(2) Check the piping
① Confirm that all bolts and nuts are securely tightened

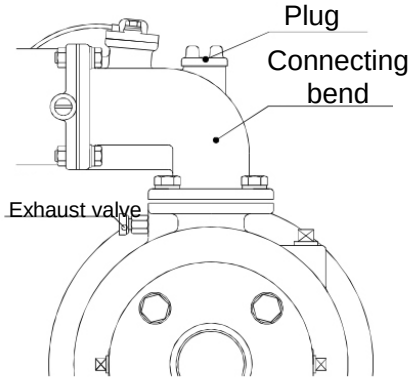
(3) Priming the pump

⚠ Cautions

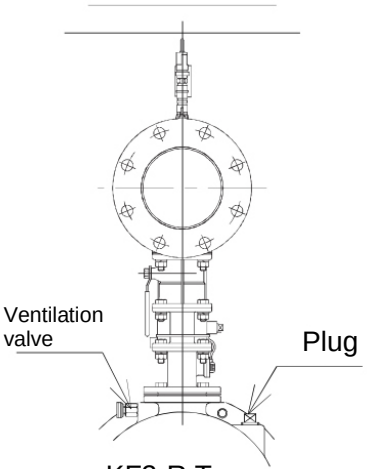
●Implement the priming procedure correctly for each pump. If the priming is not enough, empty operation might occur causing a failure.
●Turn the main power OFF at the time of priming to avoid the risk of an injury.

① Check the water level in the water tank.
② Remove the rubber bush of the motor fan cover.
<Positive suction>
③ Open the sluice valve at the suction port of the pump, and then open the ventilation valve
④ Rotate the edge axis of the motor with a flat-head screwdriver to release any air in the impeller.
⑤ Priming is completed once water starts coming out vigorously from the ventilation valve.
<Suction>
③ Open the ventilation valve, remove the plug, and then implement priming.
④ Rotate the edge axis of the motor with a flat-head screwdriver to release any air in the impeller.
⑤ Priming is completed once air bubbles stop coming out from the ventilation valve.
<Common>
⑥ Close the ventilation valve, install the plug (in the case of suction) and the rubber bush of the motor fan cover.
(4) Check the power supply
① Confirm that the voltage is within 200V±10% by turning the power ON, turn the earth leakage breaker in the control panel ON, operate the display panel on control board, and then display the power voltage.
② For the rotation direction, there is no reverse rotation because the phase sequence on the power side is an inverter operation. In the case of reverse rotation, check the connection with the motor.

<Drawing-22>



KF2 Type



KF2-R Type
(KF2-T Type)

2. Check the manual operation

(1) Check that the valves open/close

Sluice valve at the unit discharge port and piping test	→ Close
Sluice valve at the unit's suction port (In the case of positive suction) Sluice valve of the accumulator, ball valve of the pressure transmitter	→ Open

(2) Set the select switch on the control panel to "Pump" and "Manual" (Pump 1 starts).

(3) Once the pump pressure increases, open the sluice valve of the piping and test gradually and confirm that water comes out from the piping vigorously. (In the case that the lifting does not start within a few minutes, set the select switch SW1 as "Stop", and implement priming again).

(4) Once lifting has completed, close the sluice valve of the piping for testing, and set the main switch to "Stop".

(5) Check Pump 2 in the same way by setting the select switch SW2 to "2".
(Check in the same way up to No. 2 and No.3 for KF2-T Type, and up to No. 6 for KF2-R Type).

3. Check the automatic operation

(1) Set the select switch to "1/2" and "Auto" (No.1-No. 3 are automatic for the KF2-T Type, and No. 1-No. 6 are automatic for the KF2-R Type).

(2) If opening the sluice valve of the piping test gradually, the pump (one unit) starts operating. Open/close the sluice valve and test slowly and confirm that the pressure does not change drastically.

(3) Confirm that the pump stops around one minute after closing the sluice valve. The speed might reduce after operating for one minute; this is to save energy and normal.

(4) Repeat starting and stopping and confirm that the pump operates as 5, the operation explanation.

(5) In the case of the alternate/parallel or rotary unit type, confirm that the pump (one unit) starts operating when opening the sluice valve and the pressure decreases, and the pumps starts the parallel operation (two units or more) if then opening the sluice valve.

(6) In the case that the piping for test is not installed, confirm by opening/closing the sluice valve or tap at the discharge port of the unit.

4. Check the suction operation

Loosen the bypass valve of the check valve counter clockwise for around two rotations to apply a positive pressure to each suction piping. Confirm no leakage from the foot valve.

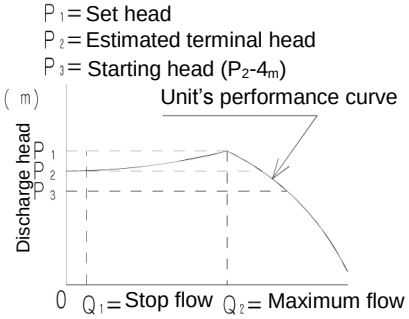
5. Adjustment of the setting head and estimated terminal head

The setting head and estimated terminal head of this unit are adjusted as <Tables-11, 12, 13> at the time of factory shipment. To use as desired, it is necessary to readjust depending on the conditions at the site. Readjust on site by following the procedure below after installation.

(1) KF2 Type – for 0.75kW: Refer to <Drawing-11>

① Adjust to the setting head to be used with the display panel on the control board in the control panel.
- Display "P. 1" by pushing the "Function" button.
- Display "h. _ _" by pushing the "△ or ▽" button.
- Adjust the head by changing the number of "_ _" with the "△ or ▽" button.
- Complete the adjustment by pushing the "Function" button. "P. 1" is displayed.

② Adjust the estimated terminal head in the same way as setting the head.
- Display "P. 2" by pushing the "Function" button.
- Display "h. _ _" by pushing the "△ or ▽" button.
- Adjust the head by changing the number of "_ _" with the "△ or ▽" button.
- Complete the adjustment by pushing the "Function" button. "P. 2" is displayed.



<Drawing-23>

(2) KF2 Type – for 1.1kW, For KF2-T Type: Refer to <Drawings-13, 15>.

① Adjust to the head setting to be used with the display panel on the control board in the control panel.
- Select the setting mode by pushing the "Function" button. (P. 1, P. 2, F_F is displayed).
- Display "P. 1" by pushing the "△ or ▽" button.
- Display "h. _ _" by pushing the "Switching" button.
- Adjust the head by changing the number of "_ _" with the "△ or ▽" button.
- Complete the adjustment by pushing the "Switching" button. "P. 2" is displayed.

② Adjust the estimated terminal head in the same way as setting the head.
- Display "h. _ _" by pushing the "Switching" button to the status of "P. 2".
- Adjust the head by changing the number of "_ _" with the "△ or ▽" button.
- Complete the adjustment by pushing the "Switching" button. "F_F" is displayed.

(3) It is possible to adjust the head of the standard product within the lifting adjustable setting range in <Table-11>.

(4) Note that in the case of “Set head＞Estimated terminal head”, operation with an estimated terminal pressure constant control is implemented, but in the case that the “Set head≦Estimated terminal head”, the operation shall be the discharge pressure at the set head.
In the case of “Set head＜Estimated terminal head”, the operation lamp blinks as the alarm for a setting mistake (KF2 Type, KF2-T Type).
(5) Adjust the KF2-R Type in the same way.

6. KF2 Type: Pressure transmitter adjustment range

<Table-11>

Operation method	Unit bore	Suction bore	Model	Motor	Standard specification		Standard set head at the time of shipment		Set head adjustable range
					Flow rate	Total head	Set head	Estimated terminal head	
	mm	mm		kW	M^3/min	m	m	m	m
Alternate	40	32	KF2-32A0.4S2	0.4	0.06	22	22	20	14~22
			KF2-32A0.4T	0.4	0.06	22	22	20	14~22
			KF2-32A0.75S2	0.75	0.06	32	32	29	20~32
			KF2-32A0.75	0.75	0.065	32	32	29	20~32
			KF2-32A1.1S2	1.1	0.06	53	53	48	30~53
			KF2-32A1.1	1.1	0.06	53	53	48	30~53
			KF2-32A1.9	1.9	0.07	65	65	59	44~65
		40	KF2-40A1.1	1.1	0.145	28	28	25	14~28
			KF2-40A1.5T4	1.5	0.14	32	32	29	20~32
			KF2-40A2.2T4	2.2	0.14	48	48	43	30~48
			KF2-40A3.7T4	3.7	0.16	65	65	59	44~65
			KF2-40A5.5T4	5.5	0.19	80	80	72	60~80
		50	KF2-50A2.2T4	2.2	0.225	32	32	29	20~32
			KF2-50A3.7T4	3.7	0.265	48	48	43	30~48
			KF2-50A5.5T4	5.5	0.24	70	70	63	44~70
			KF2-50A7.5T4	7.5	0.28	80	80	72	56~80
	50	65	KF2-65A3.7T4	3.7	0.38	32	32	29	20~32
			KF2-65A5.5T4	5.5	0.35	48	48	43	30~48
			KF2-65A7.5T4	7.5	0.38	60	60	54	44~60
Alternate / Alternate & Parallel	40	32	KF2-32A0.4S2	0.4×2 *	0.12	22	22	20	14~22
			KF2-32A0.4T	0.4×2	0.12	22	22	20	14~22
			KF2-32A0.75S2	0.75×2*	0.12	32	32	29	20~32
			KF2-32A0.75	0.75×2	0.13	32	32	29	20~32
			KF2-32A1.1S2	1.1×2 *	0.12	53	53	48	30~53
			KF2-32A1.1	1.1×2	0.12	53	53	48	30~53
			KF2-32A1.9	1.9×2	0.14	65	65	59	44~65
		40	KF2-40A1.1	1.1×2	0.29	28	28	25	14~28
			KF2-40A1.5T4	1.5×2	0.28	32	32	29	20~32
			KF2-40A2.2T4	2.2×2	0.28	48	48	43	30~48
			KF2-40A3.7T4	3.7×2	0.32	65	65	59	44~65
			KF2-40A5.5T4	5.5×2	0.38	80	80	72	60~80
		50	KF2-50A2.2T4	2.2×2	0.45	32	32	29	20~32
			KF2-50A3.7T4	3.7×2	0.53	48	48	43	30~48
			KF2-50A5.5T4	5.5×2	0.48	70	70	63	44~70
			KF2-50A7.5T4	7.5×2	0.56	80	80	72	56~80
	50	65	KF2-65A3.7T4	3.7×2	0.76	32	32	29	20~32
			KF2-65A5.5T4	5.5×2	0.70	48	48	43	30~48
			KF2-65A7.5T4	7.5×2	0.76	60	60	54	44~60

*1. Starting head=Estimated terminal head-4m (The starting head is set automatically if adjusting the estimated terminal head).

*2. Suction conditions: Positive suction 5m, up to a suction total head-6m (suction actual head-4m).

*3. Estimated terminal head at the time of factory shipment=Set head×0.9

KF2-T Type: Adjustable pressure range

<Table-12>

Operation method	Unit bore	Suction bore	Model	Motor	Standard specification				Set head adjustable range
					Flow rate	Total head	Set head	Starting pressure	
	mm	mm		kW	M^3/min	m	m	MPa {kgf/cm^2}	m
3/3 rotary units (Standard)	50	32	KF2-32T0.75G	0.75×2	0.13	32	32	0.25{2.5}	20~32
			KF2-32T1.1G	1.1×2	0.12	53	53	0.43{4.4}	30~53
			KF2-32T1.9G	1.9×2	0.14	65	65	0.54{5.5}	44~65
	80	40	KF2-40T1.5T4	1.5×2	0.28	32	32	0.25{2.5}	20~32
			KF2-40T2.2T4	2.2×2	0.28	48	48	0.38{3.9}	30~48
			KF2-40T3.7T4	3.7×2	0.32	65	65	0.54{5.5}	44~65
			KF2-40T5.5T4	5.5×2	0.41	80	80	0.67{6.8}	60~80
		50	KF2-50T2.2T4	2.2×2	0.45	32	32	0.25{2.5}	20~32
			KF2-50T3.7T4	3.7×2	0.53	48	48	0.38{3.9}	30~48
			KF2-50T5.5T4	5.5×2	0.5	70	70	0.58{5.9}	44~70
			KF2-50T7.5T4	7.5×2	0.6	80	80	0.67{6.8}	60~80
	100	65	KF2-65T3.7T4	3.7×2	0.76	32	32	0.25{2.5}	20~32
			KF2-65T5.5T4	5.5×2	0.66	48	48	0.38{3.9}	30~48
			KF2-65T7.5T4	7.5×2	0.76	60	60	0.49{5.0}	44~60
2/3 rotary units (VC43)	50	32	KF2-32T0.75G	0.75×3	0.195	32	32	0.25{2.5}	20~32
			KF2-32T1.1G	1.1×3	0.18	53	53	0.43{4.4}	30~53
			KF2-32T1.9G	1.9×3	0.18	65	65	0.54{5.5}	44~65
	80	40	KF2-40T1.5T4	1.5×3	0.42	32	32	0.25{2.5}	20~32
			KF2-40T2.2T4	2.2×3	0.42	48	48	0.38{3.9}	30~48
			KF2-40T3.7T4	3.7×3	0.48	65	65	0.54{5.5}	44~65
			KF2-40T5.5T4	5.5×3	0.6	80	80	0.67{6.8}	60~80
		50	KF2-50T2.2T4	2.2×3	0.59	32	32	0.25{2.5}	20~32
			KF2-50T3.7T4	3.7×3	0.7	48	48	0.38{3.9}	30~48
			KF2-50T5.5T4	5.5×3	0.78	70	70	0.58{5.9}	44~70
			KF2-50T7.5T4	7.5×3	0.9	80	80	0.67{6.8}	60~80
	100	65	KF2-65T3.7T4	3.7×3	1.12	32	32	0.25{2.5}	20~32
			KF2-65T5.5T4	5.5×3	1.0	48	48	0.38{3.9}	30~48
			KF2-65T7.5T4	7.5×3	1.14	60	60	0.49{5.0}	44~60

*1. Starting head=Estimated terminal head-4m (The starting head is set automatically if adjusting the estimated terminal head).

*2. Suction conditions: Positive suction 5m, up to a suction total head-6m (negative suction actual head-4m).

*3. Estimated terminal head at the time of factory shipment=Set head × 0.9

Adjustment of the accumulator filling pressure

The filling pressure of this unit is adjusted at the time of factory shipment, but in the case of adjusting the head/estimated terminal head setting, it is necessary to readjust. Readjust by following the procedure below.

① Close the sluice valve of the accumulator.

② Open the drain valve at the lower section of the accumulator and drain.

③ Adjust to the following pressure.

Gas filling pressure = (Starting pressure + Absolute pressure) / 1.25 - Absolute pressure

= (Starting head × 0.098) + 0.098 / 1.25 - 0.098MPa

{Starting head × 0.1) + 1 / 1.25 - 1kgf/cm^2}

④ Close the drain valve and open the sluice valve.

7. KF2-R Type: Adjustable pressure range

<Table-13>

Operation method	Unit bore	Suction bore	Model	Motor	Standard specification				Set head adjustable range
					Flow rate	Total head	Set head	Starting pressure	
	mm	mm		kW	M^3/min	m	m	MPa {kgf/cm^2}	m
3/3 pump rotary	65	32	KF2-32R3E0.75	0.75×3	0.195	32	32	0.25{2.5}	20~32
			KF2-32R3E1.1	1.1×3	0.18	53	53	0.43{4.4}	30~53
			KF2-32R3E1.9	1.9×3	0.18	65	65	0.54{5.5}	44~65
	80	40	KF2-40R3E1.5	1.5×3	0.42	32	32	0.25{2.5}	20~32
			KF2-40R3E2.5	2.2×3	0.42	48	48	0.38{3.9}	30~48
			KF2-40R3E3.7	3.7×3	0.48	65	65	0.54{5.5}	44~65
			KF2-40R3E5.5	5.5×3	0.6	80	80	0.67{6.8}	60~80
	100	50	KF2-50R3E2.5	2.2×3	0.59	32	32	0.25{2.5}	20~32
			KF2-50R3E3.7	3.7×3	0.7	48	48	0.38{3.9}	30~48
			KF2-50R3E5.5	5.5×3	0.78	70	70	0.58{5.9}	44~70
			KF2-50R3E7.5	7.5×3	0.9	80	80	0.67{6.8}	60~80
	125	65	KF2-65R3E3.7	3.7×3	1.12	32	32	0.25{2.5}	20~32
			KF2-65R3E5.5	5.5×3	1.0	48	48	0.38{3.9}	30~48
			KF2-65R3E7.5	7.5×3	1.14	60	60	0.49{5.0}	44~60
4/4 pump rotary	65	32	KF2-32R4E0.75	0.75×4	0.26	32	32	0.25{2.5}	20~32
			KF2-32R4E1.1	1.1×4	0.24	53	53	0.43{4.4}	30~53
			KF2-32R4E1.9	1.9×4	0.24	65	65	0.54{5.5}	44~65
	80	40	KF2-40R4E1.5	1.5×4	0.56	32	32	0.25{2.5}	20~32
			KF2-40R4E2.5	2.2×4	0.56	48	48	0.38{3.9}	30~48
			KF2-40R4E3.7	3.7×4	0.64	65	65	0.54{5.5}	44~65
			KF2-40R4E5.5	5.5×4	0.8	80	80	0.67{6.8}	60~80
	100	50	KF2-50R4E2.5	2.2×4	0.79	32	32	0.25{2.5}	20~32
			KF2-50R4E3.7	3.7×4	0.94	48	48	0.38{3.9}	30~48
			KF2-50R4E5.5	5.5×4	1.1	70	70	0.58{5.9}	44~70
			KF2-50R4E7.5	7.5×4	1.19	80	80	0.67{6.8}	60~80
	125	65	KF2-65R4E3.7	3.7×4	1.52	32	32	0.25{2.5}	20~32
			KF2-65R4E5.5	5.5×4	1.3	48	48	0.38{3.9}	30~48
			KF2-65R4E7.5	7.5×4	1.52	60	60	0.49{5.0}	44~60
5/5 pump rotary	80	32	KF2-32R5(6)E0.75	0.75×5	0.325	32	32	0.25{2.5}	20~32
			KF2-32R5(6)E1.1	1.1×5	0.3	53	53	0.43{4.4}	30~53
			KF2-32R5(6)E1.9	1.9×5	0.3	65	65	0.54{5.5}	44~65
	100	40	KF2-40R5(6)E1.5	1.5×5	0.7	32	32	0.25{2.5}	20~32
			KF2-40R5(6)E2.5	2.2×5	0.7	48	48	0.38{3.9}	30~48
			KF2-40R5(6)E3.7	3.7×5	0.8	65	65	0.54{5.5}	44~65
			KF2-40R5(6)E5.5	5.5×5	1.0	80	80	0.67{6.8}	60~80
	125	50	KF2-50R5(6)E2.5	2.2×5	0.98	32	32	0.25{2.5}	20~32
			KF2-50R5(6)E3.7	3.7×5	1.17	48	48	0.38{3.9}	30~48
			KF2-50R5(6)E5.5	5.5×5	1.3	70	70	0.58{5.9}	44~70
			KF2-50R5(6)E7.5	7.5×5	1.48	80	80	0.67{6.8}	60~80
	150	65	KF2-65R5(6)E3.7	3.7×5	1.87	32	32	0.25{2.5}	20~32
			KF2-65R5(6)E5.5	5.5×5	1.62	48	48	0.38{3.9}	30~48
			KF2-65R5(6)E7.5	7.5×5	1.9	60	60	0.49{5.0}	44~60

Operation method	Unit bore	Suction bore	Model	Motor	Standard specification				Set head adjustable range
					Flow rate	Total head	Set head	Starting pressure	
	mm	mm		kW	M^3/min	m	m	MPa {kgf/cm^2}	m
6/6 pump rotary	80	32	KF2-32R6E0.75	0.75×6	0.325	32	32	0.25{2.5}	20~32
			KF2-32R6E1.1	1.1×6	0.3	53	53	0.43{4.4}	30~53
			KF2-32R6E1.9	1.9×6	0.3	65	65	0.54{5.5}	44~65
	100	40	KF2-40R6E1.5	1.5×6	0.7	32	32	0.25{2.5}	20~32
			KF2-40R6E2.5	2.2×6	0.7	48	48	0.38{3.9}	30~48
			KF2-40R6E3.7	3.7×6	0.8	65	65	0.54{5.5}	44~65
			KF2-40R6E5.5	5.5×6	1.0	80	80	0.67{6.8}	60~80
	125	50	KF2-50R6E2.5	2.2×6	0.98	32	32	0.25{2.5}	20~32
			KF2-50R6E3.7	3.7×6	1.17	48	48	0.38{3.9}	30~48
			KF2-50R6E5.5	5.5×6	1.3	70	70	0.58{5.9}	44~70
			KF2-50R6E7.5	7.5×6	1.48	80	80	0.67{6.8}	60~80
	150	65	KF2-65R6E3.7	3.7×6	1.87	32	32	0.25{2.5}	20~32
			KF2-65R6E5.5	5.5×6	1.62	48	48	0.38{3.9}	30~48
			KF2-65R6E7.5	7.5×6	1.9	60	60	0.49{5.0}	44~60

*1. Starting head=Estimated terminal head-4m (The starting head is set automatically if adjusting the estimated terminal head).
*2. Suction conditions: Positive suction 5m, up to a suction total head-6m (negative suction actual head-4m).
*3. Estimated terminal head at the time of factory shipment=Set head×0.9

8. Normal operation
(1) Check the valves open/close

Sluice valve of piping for test, ball valve of the pressure gauge, Drain valve of the accumulator	→ Close
Suction port of the unit, sluice valve of the discharge port Ball valves of the accumulator and pressure transmitter	→ Open

(2) Check the control panel
KF2 Type
Switch SW1 → “Auto”
Switch SW2 → “1/2”

KF2-T Type
No. 1 pump select switch → “Auto”
No. 2 pump select switch → “Auto”
No. 3 pump select switch → “Auto”
Positive suction electromagnetic valve select switch → “Auto”
Water tank select switch → “No. of the water tank to be used”

KF2-R Type
No. 1 pump select switch → “Auto”
No. 2 pump select switch → “Auto”
No. 3 pump select switch → “Auto”
No. 4 pump select switch → “Auto”
No. 5 pump select switch → “Auto”
No. 6 pump select switch → “Auto”
Positive suction electromagnetic valve select switch → “Auto”
Water tank select switch → “No. of the water tank to be used”

6-8) Maintenance/Inspection

⚠ Warnings

●If the unit does not operate or an abnormality (burnt smell etc.), stop the operation immediately, shut off the power, and implement maintenance and inspection. If keep operating with an abnormality or an imperfect repair, electric shock, fire or water leakage might occur.

●If the pressure in the accumulator is low, make sure to fill with air. If filling with an explosive gas such as hydrogen, an explosion might occur.

⚠ Cautions

●In the case of turning the power OFF after not using for a long time, make sure to drain the water in the pump. If turning the power OFF with water in the pump, and the heater to prevent freezing does not operate, the pump might freeze causing damage.

●For the inverter of the main driving device of the control panel, the voltage is applied to the secondary side even when the pump is OFF, so turn the power source OFF at the time of inspection. After turning the power OFF, do not touch the charging section until the charge lamp (Red) or digital display on the control panel turns OFF, even after turning the power OFF. Electric shock or injury might occur.

●Use an insulation resistance meter of 250V or lower to measure the insulation resistance.

●At the time of inspection, confirm that the internal pressure of the pump unit is zero. Water might shoot out.

1. Daily inspection <Table-14>

Item	Point to be checked	Criteria
Pump	Water leakage of mechanical seals	No dripping
Motor	Housing temperature	Ambient temperature + 70℃ or lower
	Ball bearing	No abnormal operating sound/vibration
Unit	Starting pressure	No big variation from the set pressure value
	Electrical current	Electrical current value on the nameplate or lower
	Voltage	Within ±10% of the rated voltage
	Water leakage	No water leakage from each section

It is important to know the daily changes to find any abnormality immediately. Therefore, we recommend to keep a daily operation record.

Always keep the ball valve of the pressure gauge closed, except at the time of measurement. If it is open damage might occur.

6-monthly inspection

Item	Points to be checked	Criteria
Motor	Insulation resistance (Note 1)	1MΩ or higher
Accumulator	Fill gas pressure	(Note 2)
Control panel	Condensation in the panel	No condensation
	Relays	No abnormality such as a colour change
Pressure transmitter	Operation	No abnormal (unstable) operation

(Note 1) Measure the insulation resistance of the motor by removing the cable or using an insulation resistance meter of 250V or lower. It is impossible to measure with an insulation resistance meter of higher than 250V.

(Note 2) Measure after draining any water in the accumulator. If the fill pressure is not enough, fill with air and set the value to the value on the nameplate.

3. Consumable parts
The parts in <Table-16> are consumable parts. Replace these parts by referring to the replacement timing standard.

<Table-16>

Part No.	Part name	Standard schedule for replacement	Applicable model	Remark
30400312	O-ring K170	Each time of overhaul	KF2-32	Casing×Casing cover
30400314	O-ring K190	"	KF2-40.50 (up to 3.7kw)	
30400317	O-ring K220	"	KF2-40.50 (5.5kw or up)	
			KF2-65 (3.7kw)	
30400318	O-ring K235	"	KF2-65 (5.5kw or up)	
30400557	O-ring P65	"	KF2-32	Casing×Guide pen
			KF2-40 (5.5kW)	
30400561	O-ring P75	"	KF2-50 (5.5kw or up)	Casing×Guide pen
30400562	O-ring P80	"	KF2-40.50 (up to 3.7kw)	
30400564	O-ring P90	"	KF2-65	
30003020	Mechanical seal 20EA560-J	1 year	Up to 3.7kw	
30002810	Mechanical seal 25EA560-J	1 year	5.5kw or up	
-	Ball bearing	3 years		Indicated on the nameplate of the motor
0122	Accumulator PTD3	3 years		
69502411	Pressure transmitter	5 years		
69431	Flow sensor	3 years		
51001410	Fan DC24V	3 years	Up to 3.7kw	For inverter
51001810	Fan DC24V	3 years	5.5kw or up	
58006910	Condenser 880 μ F-200V	3 years	For 1.5kw	For inverter
58006920	Condenser 1100 μ F-200V	3 years	For 2.2kw	
58006930	Condenser 1780 μ F-200V	3 years	For 3.7kw	
58007310	Condenser 1350 μ F-400V	3 years	For 5.5kw	
58007320	Condenser 1800 μ F-400V	3 years	For 7.5kw	
-	Pressure gauge	5 years		

6-9) Disassembly/Assembly

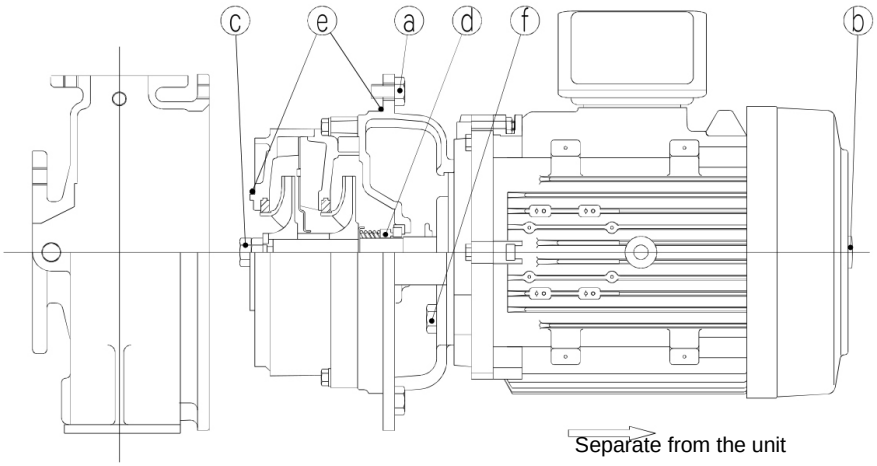
⚠ Warnings

●Only a qualified repair engineer shall implement disassembly, repair, or modification. If a repair is imperfect, electric shock, fire, or water leakage might occur.
●Do not implement disassembly, repair, or modification of the motor and control panel absolutely. Not only a failure but also electric shock or fire might occur.
Contact the unit's supplier or the service shop designated by our Company.

1. Before disassembling <Example: Failure of Pump 1>
(1) Turn the main power OFF by turning the switch No.1 on the control panel.
(2) Close the sluice valve of the suction port of Pump 1 fully.
(3) Remove the motor cable of Pump 1 from the control panel.
(4) Turn the main power ON.
(5) Set the select switch to "2"/ "Auto". The water supply will be sent only to Pump 2.
(For the KF2-T Type, set No. 2/No. 3 to "Auto", and the KF2-R Type, set No. 2-No. 6 to "Auto". The water supply will be sent only to Pump 2 and later).

2. Replacement of mechanical seal: Refer to <Drawing-24>.
(1) Remove the casing and casing cover from the unit by removing the bolts (a).
(2) Remove the rubber bush (b) of the fan cover, and remove the impeller nut (c).
(4) Remove the parts in sequence from the front side, and remove the mechanical seal (d) finally.
(5) Install a new mechanical seal. It becomes easier to insert by wetting the circumference of the cushion rubber with water. When inserting the mechanical seal, be careful not to damage the sliding surface.
(6) Assemble in the opposite sequence of disassembly.
(7) Replace the O-ring (e) with a new one.
(8) Confirm no contact by rotating the main axis after assembly.

3. Replacement of the ball bearing: Refer to <Drawing-24>
(1) Remove up to the mechanical seal in the same way as replacement of the mechanical seal.
(2) Remove the bolt (f) that fixes the motor and bracket.
(3) Remove the motor, and request a specialised factory for a replacement ball bearing.
(4) Assemble in the opposite sequence of disassembly.
(5) Replace the O-ring (e) with a new one.
(6) Confirm no contact by rotating the main axis after assembly.



<Drawing-24>

4. Replacement of the accumulator
(1) Close the sluice valve of the accumulator.
(2) Drain any water by opening the drain port at the lower section of the accumulator.
(3) Remove the accumulator by rotating it manually.
(4) Install a new accumulator, close the valve of the drain port, and open the sluice valve.

<Buy replacement parts at the shop where you bought the product>

6-10) Causes of and measures against failure

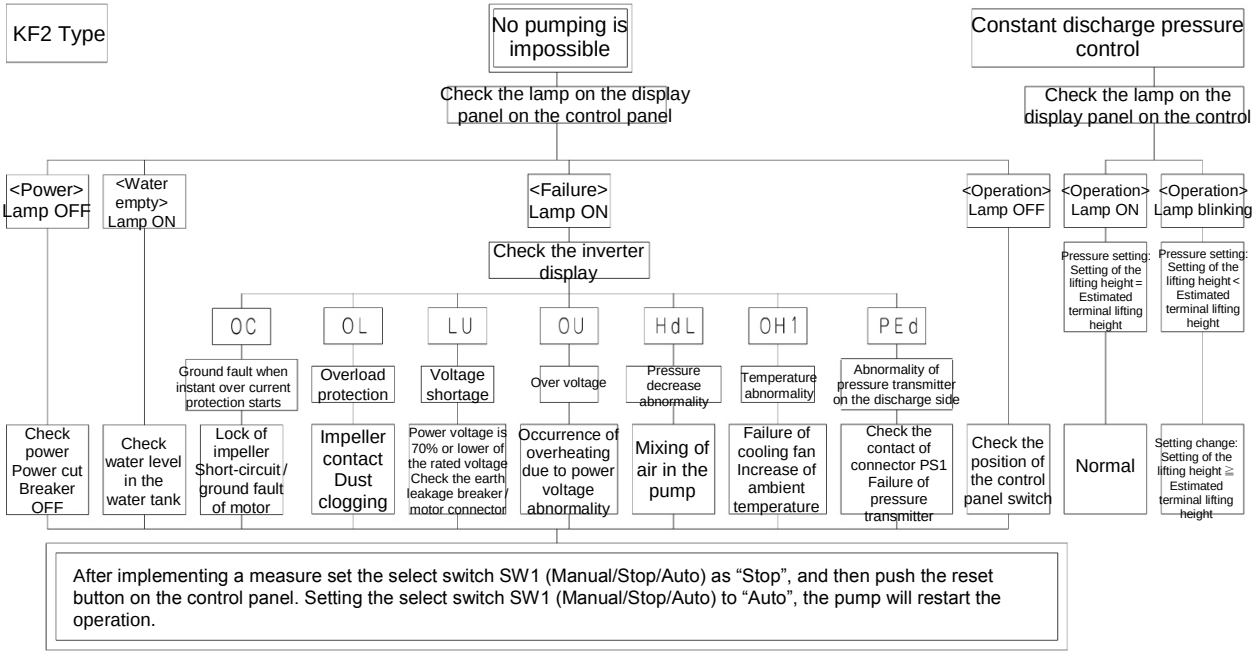
⚠ Warning

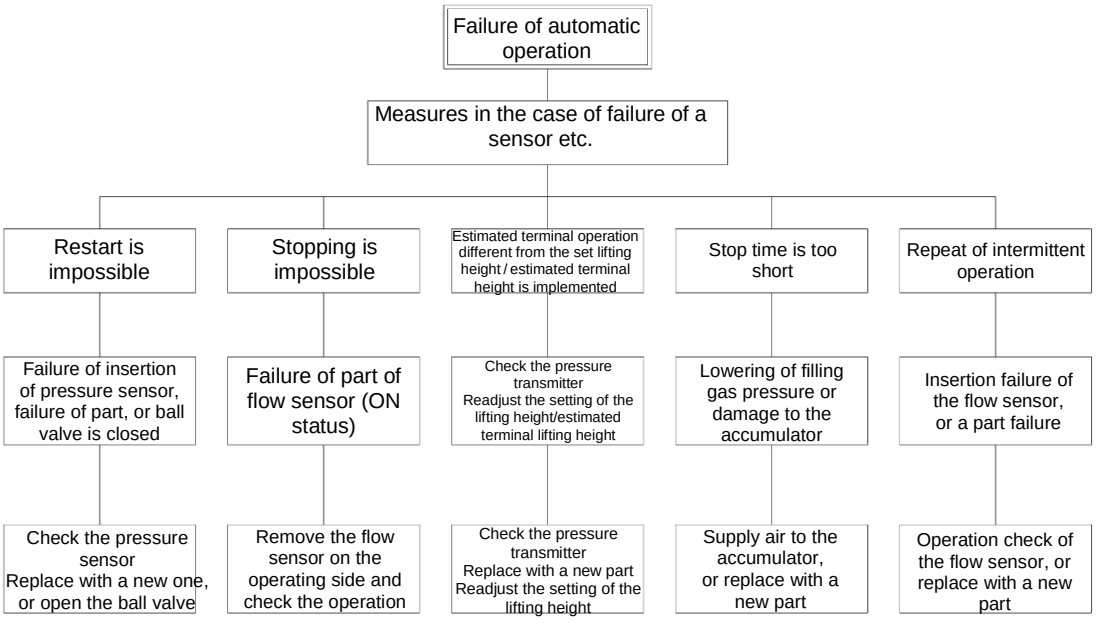
●In the case of no operation or an abnormality (burnt smell etc.), stop the operation immediately, shut the power off, and contact the unit's supplier or the service provider designated by our Company. If keep operating with an abnormality or a faulty repair, electric shock, fire or electrical leakage might occur.

1. List of failure displays
At the time of failure, the failure content is indicated digitally on the display panel on the control board. For the content and indication of failure history, refer to <P. 47/49/51/55>.

Note 1) For the failure reset, eliminate the failure's cause, then push the reset switch.

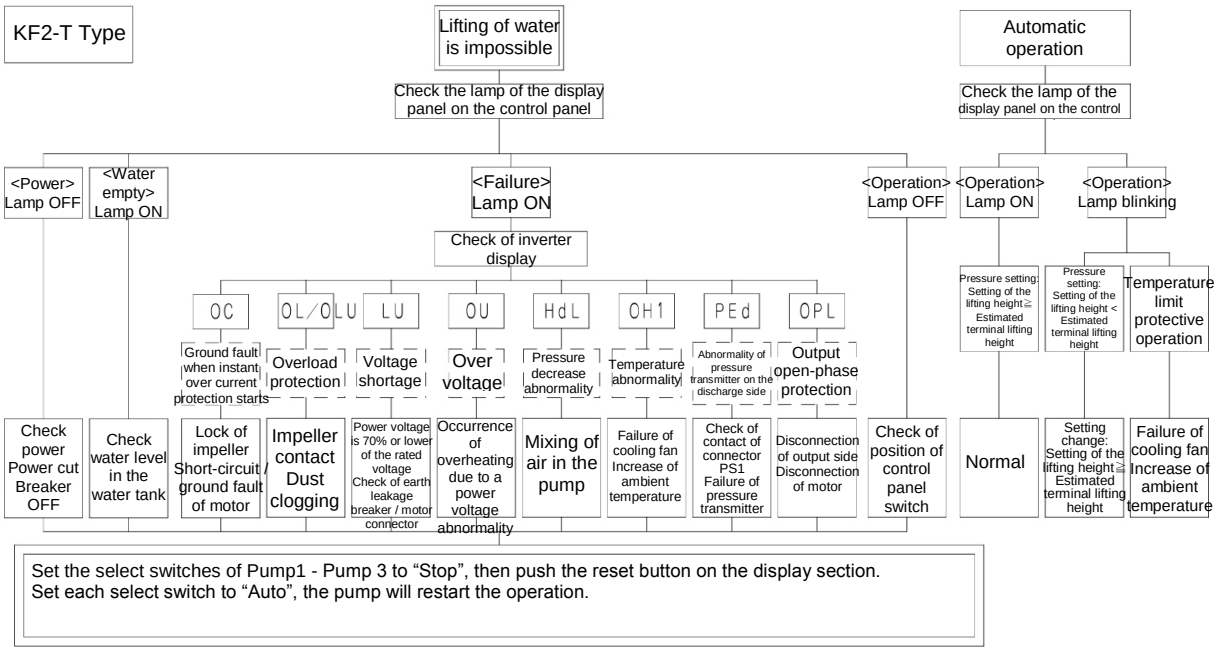
Trouble diagnosis flow sheet (Main trouble details are indicated)

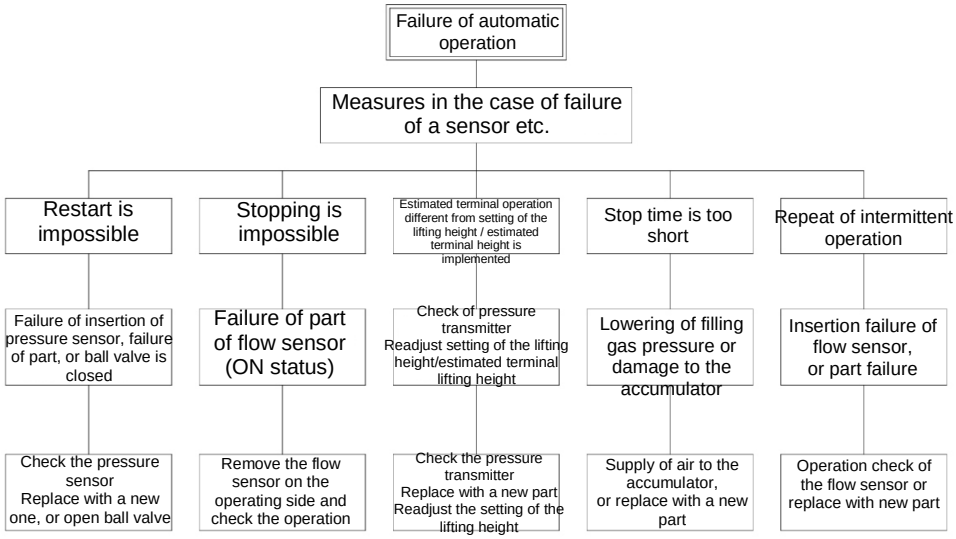




*1. If removing each sensor from the connector, the pump stops or operates slowly.

Trouble diagnosis flow sheet (Main trouble details are indicated)

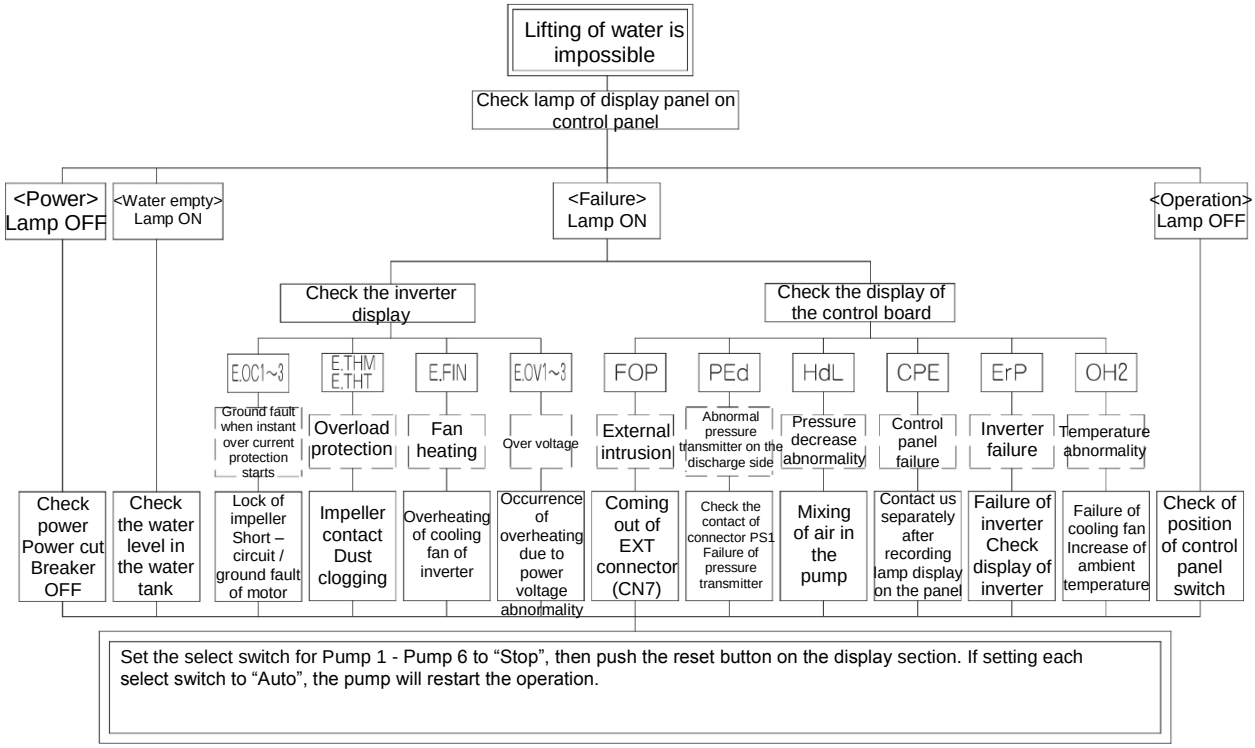


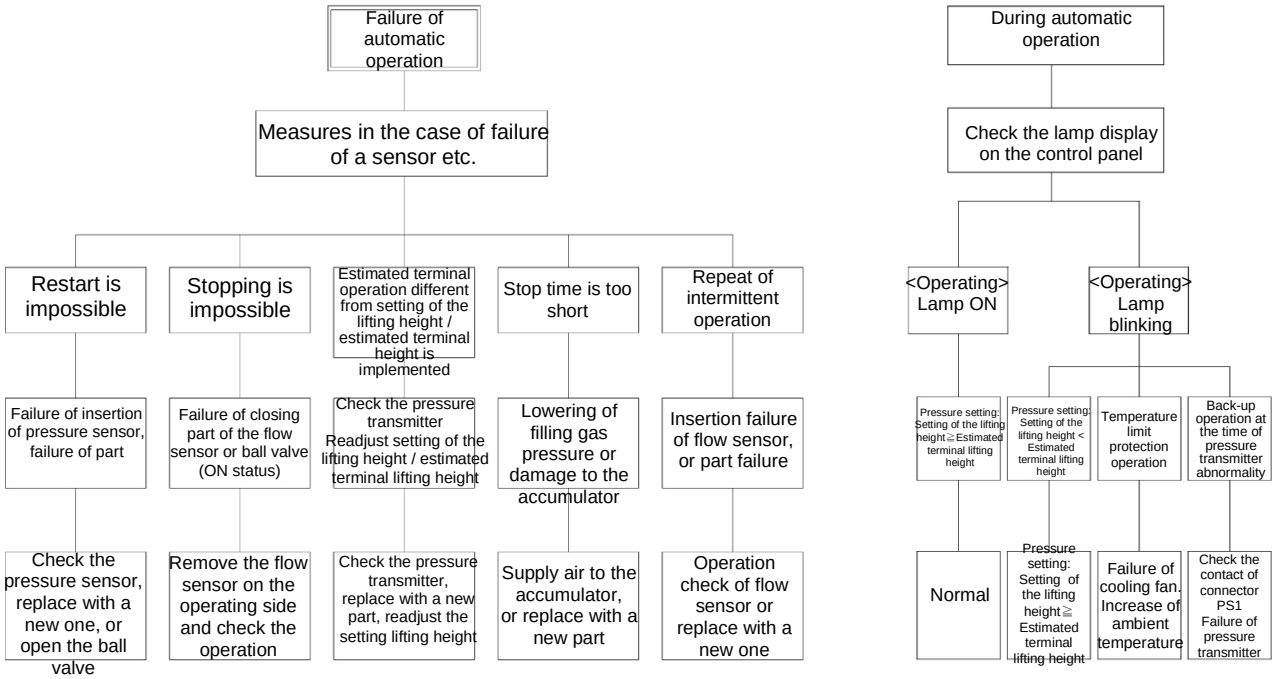


*1. If removing each sensor from the connector, the pump stops or operates slowly.

KF2-R Type

Failure diagnosis flow sheet (for major failures)





2. Causes of and measures against failure

Phenomenon	Cause	Measure
The power display light does not turn ON The motor does not rotate	The earth leakage breaker is OFF	Turn the earth leakage breaker ON
The motor rotates, but water does not come out, water comes out but the pressure does not increase	The water tank is empty (in the case of manual operation)	Supply water to the water tank
	The sluice valve is closed or half-closed	Open the sluice valve
	The pump is not full	Implement priming completely
The pump does not stop The pump operates when not using water	The switch is set to “Manual”	Set the switch to “Auto”
	Water is leaking from the piping	Inspect/Repair
The Alternate operation is not implemented	The switch is set to “Manual”	Set the switch to “Auto”
	The switch is set to “1” or “2”	Set the switch to “1/2”
The parallel operation is not implemented	The switch is set to “Manual”	Set the switch to “Auto”
	The switch is set to “1” or “2”	Set the switch to “1/2”
The number of times of starting/stopping is too many	Lowering of the pre-charge gas pressure in the accumulator	Replace the accumulator
	Damage to the accumulator	Replace the accumulator
The pressure is not stable	The ball valve of the pressure transmitter is closed	Open the ball valve
	Failure of the pressure transmitter	Replace the pressure transmitter

A mechanical squeal might occur when starting/stopping the pump, but this is normal.

7. Q&A

Question 1. “The noise of the conventional inverter was high. How about the Pumper KF Series?”

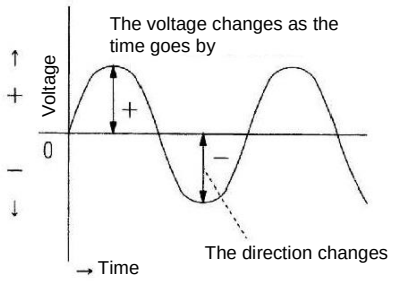
① Generally, the AC voltage is the sine wave as in [Drawing 7-1], and the number of times of periodic operation per second becomes the frequency (Hz).

② An inverter creates an AC voltage with a voluntary frequency by switching a transistor at high speed, in simple words.

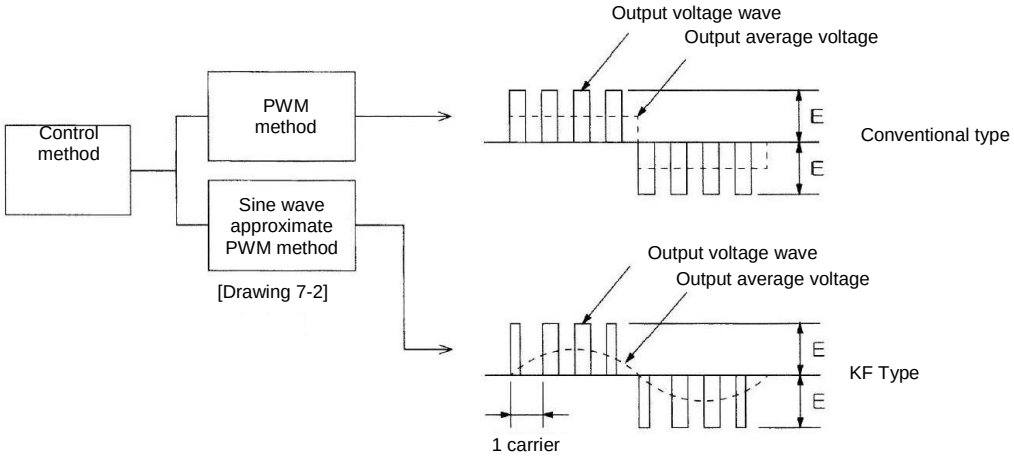
③ The silent inverter with the sine wave approximate to the PWM method and close to the general AC voltage for Pumper KF.

④ Therefore, the AC voltage created is similar to the sine wave, so the electromagnetic noise is barely generated from the motor and is silent.

⑤ For noise by the pump section, please refer to P17.



[Drawing 7-1]



[Drawing 7-2]

<Note>

The PWM method is a method to change an output voltage by generating a switching pulse a few times per cycle and changing the pulse width. The number of switching pulses generated per second is called as the carrier frequency.

Question 2. “I worry about lightning because there are many electronic parts. Is the measure against lightning perfect?”

(1) Overview: For the “Pumper KF Series”, the measures against lightning surge are standard, so no measures are necessary excluding special locations such as a mountain peak etc. However, if the grounding resistance is big, the damping effect by the lightning surge absorbing machine falls, so for the grounding line, make sure to implement D class grounding work from this device to one point on the ground with the shortest distance. However, at a place with no building around, such as around a mountain, it is recommended to implement C class grounding work.

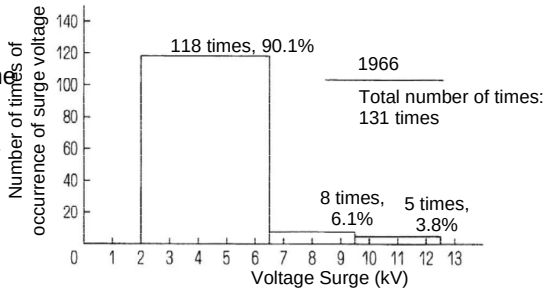
(2) Lightning surge test result
Test result: The operation continues without any problem up to 7kV. Between 10-15kV, one earth leakage breaker or inverter trips, but one unit continues operating. The status returns to normal after resetting.

[Table 7-1]

	Acceptable level	Trip level	Remark (Trip phenomenon)
Power line surge	7kV	10 ~ 15kV	For the earth leakage breaker No. 1, the inverter trips.
Water level control surge	15kV	-	-
Each organisation’s test standard	JEC – 201: 7kV Ministry of Internal Affairs and Communications: 7kV IEC801 – 5: 4kV	-	

Test method: 1.2/50 μ s × Positive/Negative 3 times each

(3) Lightning surge voltage of a low voltage system
As for the size of the voltage surge propagated on the power line and intruding into each electrical device, it is considered to be different depending on the place/measuring condition, but [Drawing 6-4] shows the lightning voltage surge measure on low voltage in-air distribution lines. Based on the measurement result in [Drawing 6-4], the lightning voltage surge intruding from the low voltage in-air distribution line, 90% was 7kV or lower, and the maximum was 12kV.
Therefore, specification of the surge protector for the Pumper KF is sufficient based on the above data.



Lightning voltage surge appears on the distribution line (Voltage between grounds)
(Report No. 64051 of the Technical Research Institute of the Central Research Institute of the Electrical Power Industry
[Drawing 7-3])

(4) Surge electric current and surge tolerance dose
A surge in the electrical current can be calculated by the formula below, and the surge tolerance dose of the standard specification is satisfactory, excluding special locations such as a mountain peak etc.

$$Is(max) = \frac{Vs(max)}{Zs(min)}$$

However, Is(max): Maximum voltage surge
Vs(max): Expected maximum voltage surge
Zs(min): Estimated minimum surge impedance

Constant table of the electrical surge current by location/device (estimated value of representative examples), Source: Manual for measures against surge of Matsushita Electronic Parts

[Table 7-2]

Location	Device	Surge in electrical current between lines		Surge in electrical current between line and ground	
		General electrical current value	Rare electrical current value	General electrical current value	Rare electrical current value
General residential area	Devices to be used indoors (Domestic electrical appliances)	100	500	500	1,000
Urban area	Device to be used outdoors (Railway, Traffic signal etc.)	200	1,000	1,000	2,000
Area around a mountain peak	(Satellite station etc.)	10,000	30,000	30,000	50,000

Unit: A, Basic waveform: 8 × 20 μ s

[Reference] Surge protector specification for the Pumper KF

Tolerance dose of surge between lines	Guarantee for 4000A × 2 times

*In the case of using around a mountain peak etc., consult us separately because the lack of tolerance dose might occur.

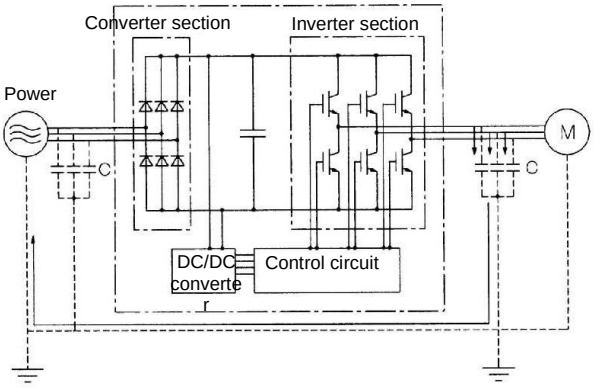
Question 3. “A noise comes into the radio etc. sometimes. Please let me know the principle and prevention etc. of such noise.”
For the “Pumper KF”, the noise filter and surge absorbing machine to reduce the internal noise generated by the inverter and external noise is built-in, and for the signal line, measures against noise such as using a shield line etc. are implemented. In the case of using the inverter singly, 1) AM radio/2) telephone/3) proximity switch/4) pressure sensor/5) position detector etc. installed already might be affected.
Here, the principle and prevention of noise generated by the inverter is explained.

[1] Noise from the inverter
[Drawing 6-5] is the overview structure drawing of the inverter. The inverter converts AC to DC (order conversion) at the converter section, converts to AC with 3-phase variable voltage/variable frequency (reverse conversion) by the PWM control by switching of 6 transistors at the motor section.
By the high speed ON/OFF switching of these 6 transistors, the switching noise is generated. The high speed ON/OFF switching releases the electrical current noise (i) to the ground through the stray capacitance (c) that exists between the inverter/cable/motor and the ground at the time of each switching.
The volume of this electrical current noise is

$$I=C \cdot dv/dt$$

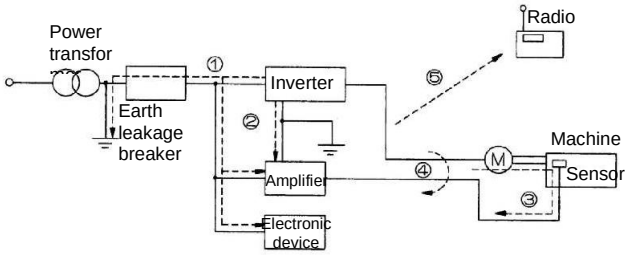
This is related to the stray capacitance (c) and dv/dt (switching speed of the transistor). This electrical current noise flows at the time of each ON/OFF switching of the transistor, so it affects the carrier frequency also.
The power DC/DC converter for the control circuit implements the switching by transistor also, so noise is generated.
Most of the frequency bands of these noises are approximately 30-40MHz or lower, and they affect AM radio that uses the low frequency band, but barely affect FM radio and TV that uses higher frequency bands.

[Drawing 7-4] Overview structure drawing of the inverter



(2) Type of noise
The noise generated by the inverted is propagated to the power side and motor side through the wiring of the main circuit, and affects a wide area from the power transformer to the motor. There are various propagation routes of noise as shown in [Drawing 7-5], but they are mainly classified to 3 routes including conductive noise, inductive noise, and radiation noise.

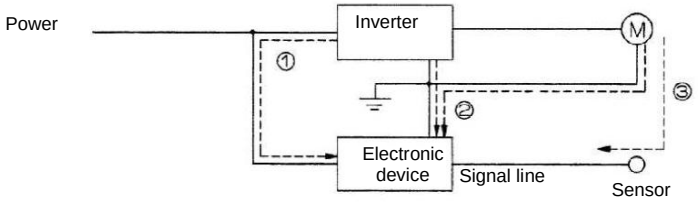
[Drawing 7-5] Propagation route of noise



(1) Conductive noise

Conductive noise is generated in an inverter that affects devices through a conductive body. There is conduction through the main circuit and power (route ①). In the case of connecting a grounding line commonly, there is conduction through route ②. Like ③, there is noise that goes through the signal line and shield line sensor.

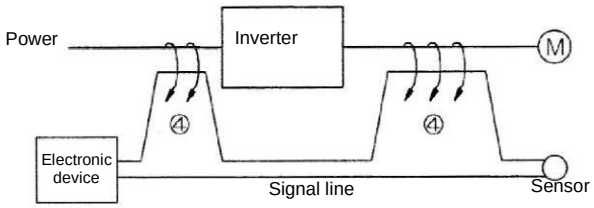
[Drawing 7-6] Conductive noise



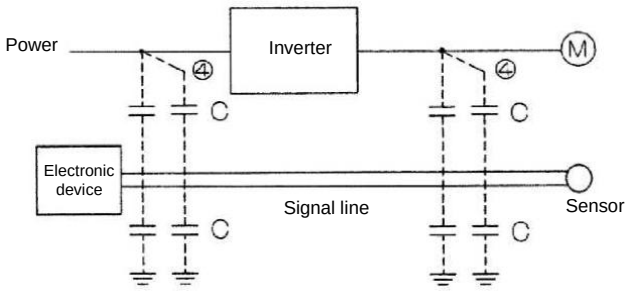
(2) Inductive noise

If the power line or signal line of a device is close to the input side/output side of an inverter with an electrical current noise, the noise is inducted to the power line or signal line of a nearby device by electromagnetic induction [Drawing 7-7] or static induction [Drawing 7-8]. This (④) is inductive noise.

[Drawing 7-7] Electromagnetic inductive noise



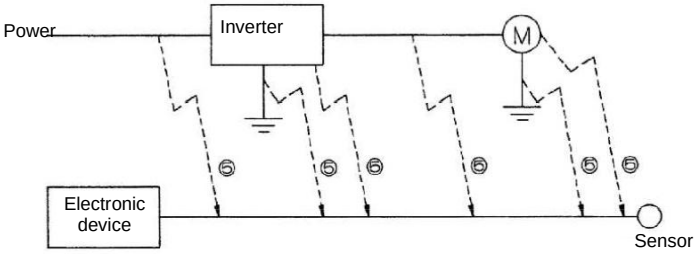
[Drawing 7-8] Static inductive noise



(3) Radiation noise

Radiation noise (⑤) generated in the inverter affects nearby devices by being radiated in the air from a power line at the input side/output side. Sometimes the radiation noise is radiated by not only wiring but also the motor frame/absorbing panel of the inverter etc.

[Drawing 7-9] Radiation noise



[Source: Material of JEMA “Good way to use inverters (about electrical noise)”]

[3] Measures against noise

(1) Pre-treatment

For the pre-treatment against the noise, there are the treatments below, and it is possible to avoid most noise troubles using these treatments.

① Separate wiring of the main circuit and control circuit.
② Store wiring of the main circuit in a metal pipe (conduit).
③ Adopt a shield line/twist shield line for the control circuit.
④ Implement proper grounding work/grounding wiring.

(2) How to implement the measures

The measures against noise depend on the propagation route and measures at the device affected by noise.

Implement the basic measure below for a device affected by noise.

① Make it difficult for noise to affect by separating the wiring of the main circuit and control circuit.

On the other hand, for the measures against noise generation take the measures below.

② Lower the level of noise by installing a noise filter etc.
③ Shut the level of noise in by adopting metal wiring conduit/metal control panels, etc.
④ Eliminate the propagation route of noise by insulating power transformers, etc.

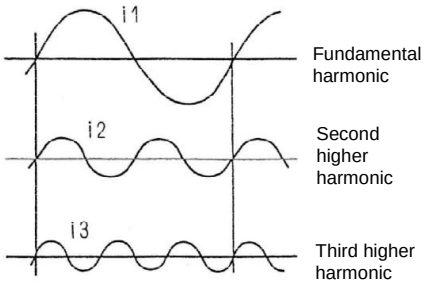
The measures and purposes to prevent noise trouble, and the propagation routes of noise are arranged and shown on [Table 7-3].

[Table 7-3] How to prevent noise

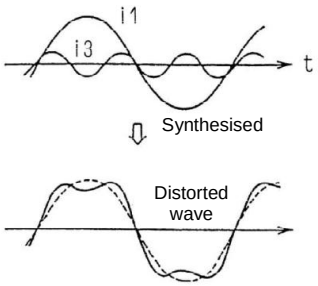
How to prevent noise		Purpose of measure				Propagation route		
		Make it hard to be affected by a noise	Propagation of noise	Shut a noise in	Lower the noise level	Conductive noise	Inductive noise	Radiation noise
Piping and installation	Separate the wiring of the main circuit and control circuit	○				○		
	Shortest possible wiring distance	○			○		○	○
	Avoidance of parallel wiring and bundling	○					○	
	Proper grounding	○			○		○	
	Adoption of a shield line/twist shield line	○					○	○
	Adoption of main circuit shield cable			○				○
	Use of metal wiring conduit			○			○	○
Control panel	Proper allocation of devices in the panel	○					○	○
	Metal control panel			○			○	○
Device for measure against noise	Line filter	○			○	○		○
	Insulate the transformer		○			○		○
Treatment for a device affected by noise	Adoption of a bypass capacitor for the control circuit	○					○	○
	Adoption of a ferrite core for the control circuit	○					○	○
	Line filter	○				○		
Other	Separate the power systems		○			○		
	Reduce the carrier frequency					○	○	○

Question 4. “Fire and smoke from the higher harmonic are serious problems. Please let me know the principle of and measure against the higher harmonic.”
The distortion of voltage caused the higher harmonic voltage generated when using an electronic device might cause damage such as heating/burning of an electrical circuit, and fire or smoke might occur. Recently, the number of disorders whose cause might the high-frequency is increasing, so the Department of Energy, MITI created the “guideline” and announced details to the related industries. For the “Pumper KF”, the reactor panel is prepared as a special accessory to suppress high-frequency electrical current.

[1] What is higher harmonic?
Higher harmonic is defined as a frequency with an integral-multiplied basic wave (the power frequency generally), and one basic wave and multiple high frequencies synthesised together as one is called a distorted wave. (Refer to [Drawing 7-10])
The distorted wave includes the higher harmonic at the high-frequency zone (kHz-MHz order) generally, but the higher harmonic treated for distribution systems is normally up to 40-50 (up to 3kH), and the characteristic is different from the problem of random high-frequency zones.



[Drawing 7-10] Basic wave



[Drawing 7-11] Distorted wave

[Table 7-4] Difference between higher harmonic and noise

Item	Higher harmonic	Noise
Frequency	Normally 40-50, 3kHz or lower	High-frequency (A few 10kHz-MHz orders)
Environment	Against wiring / power impedance	Against space, distance wiring route
Quantitative grasp	It is possible to calculate logically	Generated randomly, it is impossible to grasp quantitatively
Volume generated	Almost proportional to load capacity	Depending on the electrical current changing rate (Bigger if switching is faster)
Tolerance dose of affected devices	Specified by the standard for each device	Varies depending on the maker’s device specification
Example of measures	Install a reactor (L)	Extend the distance (L)

[2] Volume of higher harmonic generated by an inverter
Rectifier/AC power adjuster etc. are the generators of the higher harmonic.
The converter section of a general inverter consists of a rectifier circuit that generates the higher harmonic.
The higher harmonic generated by the inverter to the power side depends on the conditions such as the control method (PWM, PAM) and existence/non-existence of a power factor improving reactor, etc.

[3] Material

[Higher harmonic suppression measures]
(The content created by the Department of Energy, MITI (issued in September 1994) and announced to the related industries).

3-1) Higher harmonic suppression measures by users receiving power at a high voltage or special high voltage.

1. Purpose
The purpose of this guideline is to present the technical requirements to suppress the higher harmonic electrical current generated by use of electrical equipment by complying with the technical standards based on the electricity utility industry law and considering the higher harmonic environmental target level for commercial electrical systems (hereinafter referred to as the “system”) for users who receive power at a high voltage or special high voltage from the system.

2. Scope
(1) The users to which this guideline applies are users corresponding to any of the items below (hereinafter referred to as the “specific users”).
① A user receiving power from the system at 6.6kV and whose total capacity by considering higher harmonic occurrence rate by each kind of higher harmonic generating device (hereinafter referred to as the “equivalent capacity”) is 50kVA or higher.
② A user receiving power from the system at 22kV or 33kV and whose total equivalent capacity is 300kVA or higher.
③ A user receiving power from the system at 66kV or higher and whose total equivalent capacity is 2,000kVA or higher.
(2) In the case of calculating the equivalent capacity of (1), the target higher harmonic generating devices shall be other than devices to which the “Guideline for home electrical appliances/general products with higher harmonic suppression” apply.
(3) This guideline shall apply in the case that a specific user installs (new/additional) or replaces a higher harmonic generating device corresponding to (2). It shall apply in the corresponding case of installing (new/additional) or replacing a higher harmonic generating device corresponding to (2).

3. Calculating the outflowing electrical current of the higher harmonic
The calculation method of the higher harmonic outflow electrical current from a specific user to the system shall be as below.
(1) The higher harmonic outflow electrical current shall be a value after totalling the higher harmonic electrical currents generated at the rated voltage operation status of each higher harmonic generating device multiplied by the maximum operating rate of the higher harmonic generating device.
(2) The higher harmonic outflow electrical currents shall be totalled by each degree of the higher harmonic.
(3) The degree of the target higher harmonic shall be 40 or less.
(4) In the case that there is equipment to reduce the higher harmonic outflow electrical current, it is assumed that it is possible to consider the reduction effect.

4. Upper limit of outflowing electrical current of the higher harmonic
The upper limit of the higher harmonic electrical current permitted to outflow from a specific user to the system shall be the value after multiplying the higher limit of the higher harmonic electrical current outflow per 1kW of contracted power for the specific power shown in [Table 6-12] with the contracted power of the specific user (Unit: kW) by each degree of the higher harmonic.

5. Implementation of suppression measures against higher harmonic outflow electrical current
The special user shall take necessary measures to suppress a higher harmonic outflow electrical current to be the same as or below the upper limit of the higher harmonic outflow electrical current.

[Table 7-5] Upper limit of higher harmonic outflow electrical current per contracted power (1kW)

(Unit: mA/kW)

Receiving voltage	5th	7th	11th	13th	17th	19th	23rd	Above 23rd
6.6kV	3.5	2.5	1.6	1.3	1.0	0.9	0.76	0.70
22kV	1.8	1.3	0.82	0.69	0.53	0.47	0.39	0.36
33kV	1.2	0.86	0.55	0.46	0.35	0.32	0.26	0.24
66kV	0.59	0.42	0.27	0.23	0.17	0.16	0.13	0.12
77kV	0.50	0.36	0.23	0.19	0.15	0.13	0.11	0.10
110kV	0.35	0.25	0.16	0.13	0.10	0.09	0.07	0.07
154kV	0.25	0.18	0.11	0.09	0.07	0.06	0.05	0.05
220kV	0.17	0.12	0.08	0.06	0.05	0.04	0.03	0.03
275kV	0.14	0.10	0.06	0.05	0.04	0.03	0.03	0.02

3-2) Home electrical appliances/general products with higher harmonic suppression measures

Excerpt from the guideline for home electrical appliances/general products with higher harmonic suppression measures

1. Purpose

This guideline presents the “Suppression level of the higher harmonic generated” and the “measuring method” necessary when designing/manufacturing home electrical appliances/general products by considering the higher harmonic environment target level of commercial electrical systems.

Note 1: For the higher harmonic environmental target level of electrical systems, 5% is said to be reasonable for the 6.6kV distribution system and 3% is said to be reasonable for a special high system. (Source: “Electricity infrastructure enforcement committee”, a private committee of the Director of the Department of Energy, MITI. Report of May 1987).

Note 2: For the suppression target of the higher harmonic generated, suppression of 25% is presented for home electrical appliances/general products, and suppression of 50% for special demand electrical appliances, from the current total volume by considering the diffusion and demand forecast of devices in 2000. (Source: Expert committee for measures against higher harmonic of Electricity Technology Research Association. Report of June 1990).

Note 3: Respect the spirit of the GATT standard code (elimination of non-tariff barriers generated by standards, etc.), consider the suppression target above, and consider the existence/non-existence of special circumstances in Japan based on compliance with the IEC standard.

2. Scope

Shall apply to electrical/electronic devices with rated voltages of 20A/phase or lower and used by connecting to a commercial electricity system of 300V or less. However, it is not obstructed to apply to items other than these.

3. Terms

The meanings of the main terms used in this guideline shall be as below.

(1) The commercial electricity system shall mean a demand house wiring connected to an electrical system owned by an electric company (including an outlet).

(2) The electronic transformer for illumination device shall mean a transformer that is the whole or a part of such semiconductor element, transformer, choke coil, condenser etc., integrated or separated, and to operate an electric bulb with a frequency different from the frequency of the power source (generally transforms a commercial frequency to a higher harmonic) (hereinafter referred to as the “Electronic transformer”).

(3) The electric bulb type fluorescent lamp shall mean a fluorescent lamp for which a luminous tube, starter and stabiliser are integrated (there parts are irreplaceable) and a screw-in port is used.

(4) The illumination device shall mean a lamp control device such as a dimming device, stabiliser, electronic transformer, etc. (hereinafter referred to as the “lamp control device”), illumination device or electric bulb type fluorescent lamp.

[Table 7-6] Limit Value A

Higher harmonic degree n	Maximum permitted higher harmonic electrical current A [×(230/Vnom)’ *
Odd higher harmonic	
3	2.30
5	1.14
7	0.77
9	0.40
11	0.33
13	0.21
15 ≤ n ≤ 39	0.15 x (15/n)
Even higher harmonic	
2	1.08
4	0.43
6	0.30
8 ≤ n ≤ 40	0.23 x (8/n)

*Note: The calculated value of “value in the table×(230/Vnom)” shall apply in the case of voltage whose rated voltage (Vnom) is other than a power source system of 220V/230V/240V as the limit value. In the case that the rated voltage of a device is indicated in the voltage range, calculate by setting the nominal voltages of the usable electrical systems as Vnom.

(However, in the case of electrical systems of 220V/230V/240V, Vnom shall be 230V).