MEKANT User Manual

Ventilator System

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Definitions

This operator's manual uses three special indicators to convey information of a specific nature. They include as follow:

Warning

Indicate a condition that can endanger the patient or the ventilator operator.

Caution

Indicate a condition that can damage the equipment.

NOTE :

Indicates points of particular emphasis that make operation of the ventilator more efficient or convenient.

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Section ١ : Introduction

This operator's manual explains the way of installation and usage for MEKANT. Notice for use explains general information to be careful while using the product and other notices are written with each function. Users are recommended to be aware of notice for use and all menus before using the product.

This operator's manual is allowed to use by doctors or authorized persons who are permitted to use, or designed to use by qualified and trained persons for using this products.

Service, test, correction and main continuous working will be written in service manual of MEKANT Ventilator. However, service manual is allowed to be possesed by authorized persons by MEKICS.

1-1. Warnings and Cautions

Warning

- Please make sure to use MEKANT by authorized persons and read the manual before use. Check the setting figure of various sensors and devices before use. Users shall check out whether the environment is OK before use.
- Please be aware of the manual provided by the manufacturer when it is used or kept.
- Do not use it near inflammable anesthetic to avoid any possible explosion.
- Do not disassemble or open the main body to avoid electrical impulse. Disassembly of the equipment shall be allowed by service staffs approved by MEKICS Co., Ltd.
- Users shall be careful with circuit joint to be connected with patients.
- Always shall be careful with leakage of electrical current and consult with hospital technical engineer if any doubt.
- In case of abnormal working or any damage in the equipment, it shall not be used for patients.
- Do not touch patient, table or the equipment if a defibrillator is used.
- Disposable stuffs and disposable circuit for patients shall not be reused.
- Reusable stuffs used for patients shall be sterilized or washed for reuse.
- Check out the level before setting alarm. Alarm limitation shall be done for the current selected group. Alarm setting can be changed by level change.
- Do not correct calibration while used for patient. Please correct it after disconnection from patient if any doubt.
- Insulate power source in case that the equipment is wet and call a hospital technical engineer.
- Please connect earth cable to earth connection port to protect patients and the product.
- Do not disassemble the product in any case.
- Do not install the various kinds of sensor to patients too strongly and not to be entangled.
- Do not reuse it if you find this symbol on the accessory, which means disposable stuff.
- MEKANT shall be tested regularly if it is working in normal condition.
- Accessories are aseptic products, so the package shall not be torn before use and products shall be free from any defects or cracks.

Caution

- MEKANT as respiration assistant equipment for adult helps for normal breathing by setting breathing way, breathing volume, breathing times, oxygen density, breathing rate etc in order to solve hypoxia to be appeared from emphysema of the lungs patients or respiratory disease patients. It is respiratory assistant equipment with various alarm function and safety device for safe respiration management, but above all, should be used together with other clinical information for patients' safety and diagnosis.
- Avoid the place where there is moisture.
- Do not handle the equipment with wet hands.
- Avoid the place under direct rays.
- Use the equipment within the limits of temperature ١٠ ~ ٤٠ centigrade and humidity ٣٠ ~ ٧٥%
- Do not place the equipment near electronic heater.
- Do not place the equipment under high humidity and bad ventilation.
- Do not place the equipment where it is possible to take vibration or sudden shock.
- Do not place the equipment where to be damaged by explosive gas or chemicals.
- Protect the equipment from dust or metal scrap.
- Pull out power code with plug grasped, instead of cable.
- Check out the main equipment and sensor at the same time after cleaning the equipment. Do not use if there is any damage in the equipment.
- Make the cable and sensor clean after use. Clean them by towel with alcohol soaked and do not use benzene or gasoline.
- Do not use the equipment in dangerous place. Always be careful with the possibility of bad influence by environment.
- It is possible to be flew more current than allowed when the assistant device is used. Consult with hospital engineer or authorized local dealer.
- Check out the basic auxiliary device regularly. Do not use a damaged or electrical unstable device. Consult with hospital engineer if any doubt.
- Do not use the goods beyond standard certified one. This product shall be used under standard certification. Manufacturer does not take responsibility for the problem occurred while using the product beyond standard certification.
- The product can be disassembled by educated and authorized staffs. If a user violates this item, after sales service is not provided.

- Do not install the various kinds of sensor to patients too strongly and not to be entangled.
- Do not place the product where it is possible to fall to a patient.
- Do not move the equipment when power code or high pressure hose cage is connected. It will be harmed for patient or the equipment has an error by itself
- If a measured figure is turned out not to be correct, consult with hospital engineer or authorized local dealer.
- Connect the equipment isolated from other devices electronically for patients' electrical safety.
- Accessories of MEKANT shall be used with the ones provided by MEKICS or MEKICS's designated dealer or listed in the manual. MEKICS or MEKICS's designated dealer provide standard certified products only.
- MEKANT shall be tested regularly if it is working well.
- Turn off main switch located backside of the product after use.
- Place the product in stable position.
- Use the sensor and cable provided and designated by manufacturer, and consult with hospital engineer or authorized local dealer if you want to use other products.
- Replace the disposable sensor after use.
- Sep up the equipment when it is needed.
- Minimize patient's move when it is used.
- Make high pressure hose and cable clean after use. Clean them by towel with alcohol soaked and do not use benzene or gasoline.
- The Oxygen Air pressure which is impressed pneumatic block should be between ٣٥PSI and ٩٠PSI. Otherwise, it would affect the equipment.
- Move the equipment with fastened to avoid any possible damage to other products or people by the monitor or cable.
- Basically, MEKANT is designed not to have functional disorder by surrounded electronic wave. But, it is possible to be occurred any disorder due to high frequency of surrounding. It may be possible to calculate wrong figure, lose present figure or show noisy wave. Please ask MEKICS technical service center or local distributor if you need help.
- Please turn off the power to recharge the battery when it is not used.
- MEKANT ventilator system is a product conforming to Class II a.

١-٢. General Description

MEKANT as respiration assistant equipment for adult helps for normal breathing by setting breathing way, breathing volume, breathing times, oxygen density, breathing rate etc in order to solve hypoxia to be appeared from emphysema of the lungs patients or respiratory disease patients.

It is a respiration assistant equipment with various alarm function and safety device for safe respiration management, but above all, should be used together with other clinical information for patients' safety and diagnosis

١-٢-١. Front picture and the explanation

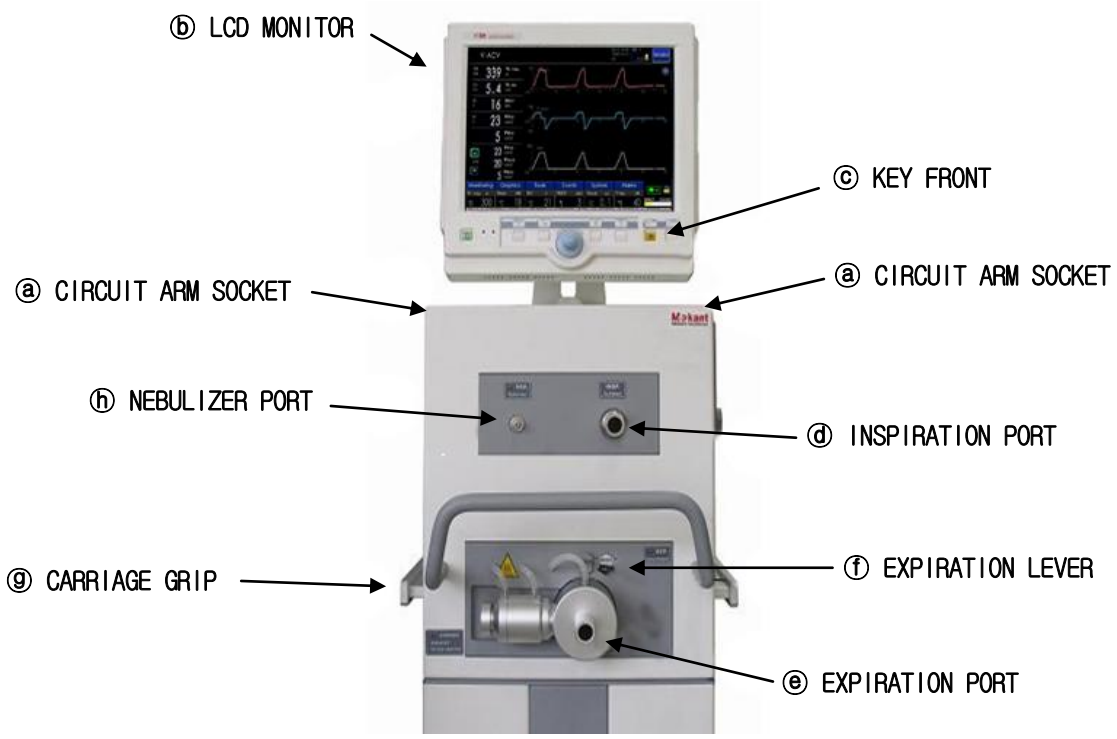


Figure ١-١. Front picture

Part	Description
ⓐ **CIRCUIT ARM SOCKET**	Install Circuit Arm for patient.
ⓑ **LCD MONITOR**	Show the condition of various ventilators and patients.
ⓒ **KEY FRONT**	Key button and encoder.
ⓓ **INSPIRATION PORT**	Joint hole to connect to patient.
ⓔ **EXPIRATION PORT**	Joint hole to connect from patient.
ⓕ **EXPIRATION LEVER**	Lock or unlock lever for Expiration Assembly.
ⓖ **CARRIAGE GRIP**	Using to move the ventilator.
ⓗ **NEBULIZER PORT**	Connection to spray medicines

Table ١-١. Front picture description

Warning

Be careful because heated exhalation assembly due to moisture during exhalation.

١-٢-٢. Back side picture and the explanation

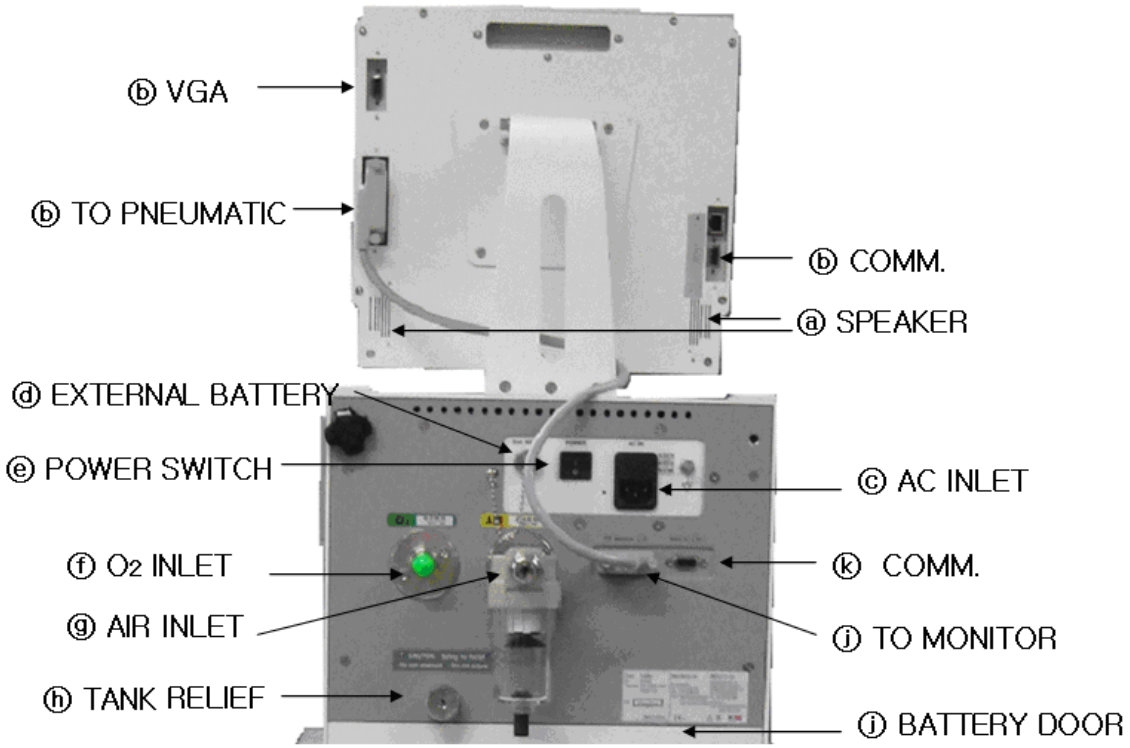


Figure ١-٢. Back side picture

Part	Description
ⓐ **SPEAKER**	For alarm and sound.
ⓑ **VGA** ⓑ **COMM** ⓑ **TO PNEUMATIC**	VGA cable connection hole to show patient condition on the other Monitor. Cable connection hole to connect PC or central connection. Connection hole to connect to the main body.
ⓒ**AC INLET**	Connection hole for AC power input.
ⓓ**EXTERNAL BATTERY**	Connection hole for external battery.
ⓔ**POWER SWITCH**	Power on/off switch for common use.
ⓕ**O$_2$ INLET**	Connection hole to connect to main body using high pressure hose to approve O_2 gas.
ⓖ**Air INLET**	Connection hole to connect to the main body, using high pressure hose to approve air gas. Device to filter the moisture in the Air.
ⓗ**TANK RELEAF**	Outlet to exhaust the over pressed air when the pressure of air tank is over than ۴۰ PSI.
ⓘ**BATTERY DOOR**	Door to replace the internal battery.
ⓙ**TO MONITOR**	Connection for monitor.
ⓚ**COMM**	Connection hole for pneumatic communication.

Table ۱-۲. Back side picture description

Warning

You should be careful with battery's polarity when it is exchanged. Products can be damaged when polarity is connected wrongly.

It should be careful of battery's terminal to be short on the metal part

١-٢-٣. Left side picture and the explanation

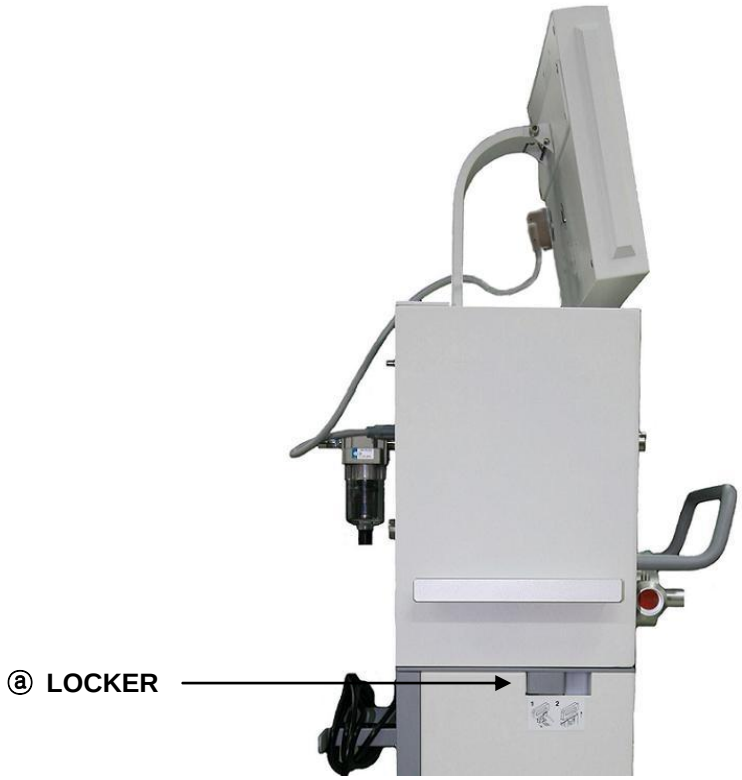


Figure ١-٣. Left side picture

Part	Description
ⓐ LOCKER	Locker to disassemble main body with cart. Pull to unlock and push to lock.

Table ١-٣. Left side picture description

١-٢-٤. Right side picture and the explanation

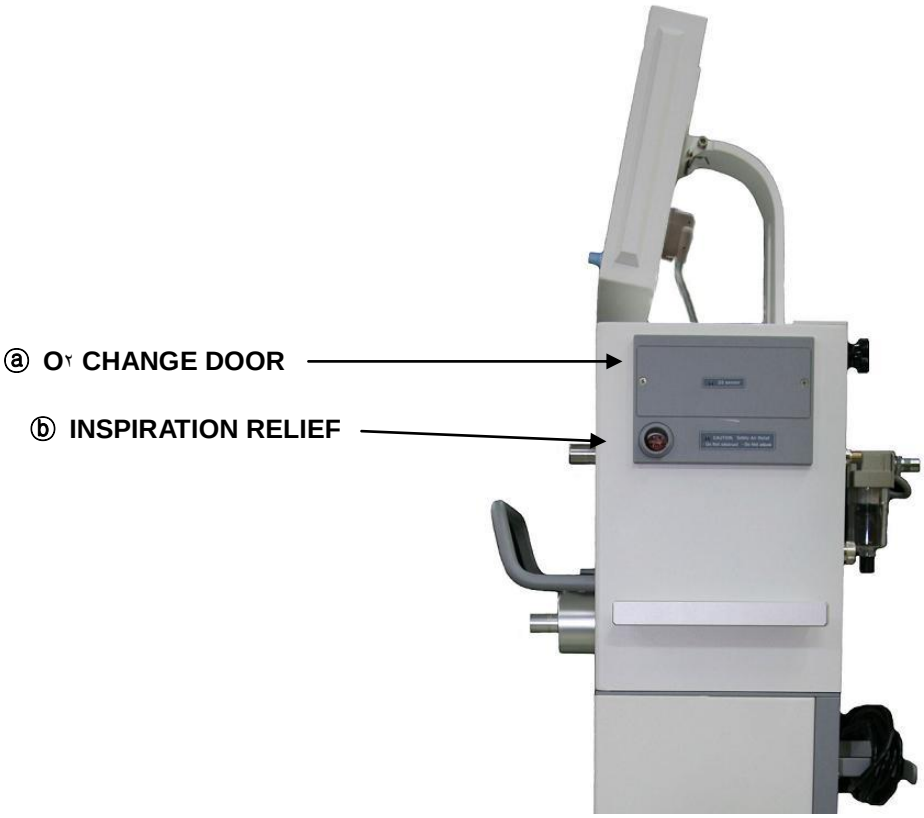


Figure ١-4. Right side picture

Part	Description
ⓐ **O٢ CHANGE DOOR**	Door to be used for exchanging O٢ Sensor.
ⓑ **INSPIRATION RELIEF**	Safety valve to exhaust by software, hardware and mechanically when the equipment is out of order.

Table ١-4. Right side picture description

Warning

Do not stop up safety valve to exhaust by software, hardware and mechanically when the equipment is out of order.

١-٣. Specifications

١-٣-١. Features

User friendly POP-up Menu with rotary and push/pull Encoder.
١٠٠% O_2, Inspiration Pause, Expiration Pause, Key-Lock ,
Manual and/or Auto Nebulizer
Dual Alarm (Speaker / Buzzer) system
External battery (for Mobile application)

١-٣-٢. Electrical Specifications

AC input voltage	١٠٠ - ١٢٠ VAC, ١٠A ٥٠/٦٠ Hz ٢٠٠ - ٢٤٠ VAC, ٥A ٥٠/٦٠ Hz
AC input FUSE Rating	٢٥٠V/٦.٣A
Power consumption	٨٤ W max
External DC input voltage	١٢V @ ٧A Pb battery
Internal battery	Battery ; ١٢V / ٧A Pb battery Operating time: ٣ hours minimum . Recharge time; ٤ Hours max. Please change it after ٢ years use. It can be used for ٣٠ minutes normally. On the other hand, it will be more than ٣٠ minutes if power consumption is small.
Communication	Central interface ; RS-٢٣٢ serial interface Baud rate ١١٥,٢٠٠bps, Upgrade (Main board, Pneumatic board)
Display	١٢.١" LCD monitor, ٨٠٠*٦٠٠,

١-٣-٣. Functional Specifications

MODE

V-ACV Volume Assist Controlled Ventilation
Controlling patient's mechanical artificial respiration based on air volume and adjusting inspiration and exhalation time by force.

V-SIMV Volume based Synchronized Intermittent Mandatory Ventilation
Controlling artificial respiration based on air volume in accordance with patient's voluntary respiration.

SPONT Spontaneous Ventilation
Give pressure support centering on voluntary respiration.

P-ACV Pressure based Assistance Controlled Ventilation
Controlling patient's mechanical artificial respiration based on pressure.

P-SIMV Pressure based Synchronized Intermittent Mandatory Ventilation
Controlling artificial respiration based on pressure in accordance with patient's voluntary respiration.

tBiLEVEL Same as SPONT and exist Upper PEEP (Refer to SPONT mode)

NIV Non Invasive Ventilation
During artificial respiration by mask type, not tubing type, P-ACV working in allowance of air leakage. (Refer to P-ACV mode)

PRVC Pressure Regulated Volume Controlled Ventilation
Breaths are delivered mandatorily with a constant flow to assure present volumes.

AUTO Start quickly according to body weight. (Working in P-ACV mode)

SETTING PARAMETER

	Setting range	Condition	Default
BW	٣ kg ~ ١٥٠ kg		١٠ml/kg
Pressure	٥ ~ ٨٠ cmH_2O	±(١.٧ + ٤% of the actual reading) cmH_2O	٣٠ cmH_2O
Plateau Time (pause)	٠ ~ ٢ sec		٠.١ sec
PEEP	٠ ~ ٤٥ cmH_2O	±(١.٧ + ٤% of the actual reading) cmH_2O	٣ cmH_2O
High PEEP	٥ ~ ٤٥ cmH_2O	±(١.٧ + ٤% of the actual reading) cmH_2O	+١٥ cmH_2O
Low PEEP	٠ ~ ٤٥ cmH_2O	±(١.٧ + ٤% of the actual reading) cmH_2O	+٣ cmH_2O
High PEEP time	٠.٢ ~ ٢٤ sec	±١٠%	١ sec
Low PEEP time	Infinite		

	Setting range	Condition	Default
Inspiration time	٠.٢ ~ ٩.٩ sec	±١٠%	١ sec
Fend	٢٥ ~ ١٠٠ %		١٠٠ %
TRISE	٠.١ ~ ٠.٥	± ٠.٠٥	٠.١sec
EnSENSE %	١٠ ~ ٦٠ %		٣٠ %
ExSENSE %	١٠ ~ ٦٠ %		٣٠ %
Pressure Support	٠ ~ ٤٥ cmH_2O	±(١.٧ + ٤% of the actual reading) cmH_2O	٠ cmH_2O
Trigger sensitivity Pressure	٠.٥ ~ ٢٠ cmH_2O	±(١.٧ + ٤% of the actual reading) cmH_2O	٥ cmH_2O
Trigger sensitivity Flow	٠.٥ ~ ٢٠ L/min	±١٥% (VMIN> ٢lpm) ±٠.٤lpm (VIMIN≤ ٢lpm	٥ lpm
Volume	٥ ml ~ ٢٥٠٠ ml	±١٥% (VTIDAL> ١٠٠ml) ±٢٠ml (VTIDAL≤ ١٠٠ml)	١٠ ml/kg
Rate	٢ ~ ١٢٠ bpm	±٢bpm	٢٠ bpm
O_2 %	٢١ ~ ١٠٠ %	±٣%	٣٠ %

	Setting range	**Default**
Nebulizer	١٠ ~ ١٨٠ min	off
	Limited ٢٠٠ml	
	Flow trigger	
	base flow cannot use	
Inspiration pause	Resistance measurement	off
Expiration pause	Compliance measurement	off
Manual Inspiration	Setting tidal volume	off
١٠٠% $O_٢$	3 minutes	off

AUTO MODE(Emergency Start Ventilation)

	Setting range
I : E	١:٢
$O_٢$	٦٠ %
Mode	PACV
Inspiration Pressure	٢٥ $cmH_٢O$
Inspiration time	١ sec
Expiration time	٢ sec
Respiration rate	٢٠ bpm
PEEP	٣ $cmH_٢O$
Trigger type	Pressure
Trigger sensitivity	٣ $cmH_٢O$
Rise %	٥٠ %
Alarm limit	Auto set
E-sense	٣٠ %

Alarms

	Setting range
PRESSURE HIGH	۵ cmH_2O ~ ۱۲۰ cmH_2O
PRESSURE LOW	۰ cmH_2O ~ ۵۰ cmH_2O
VTIDAL HIGH	۵ ml ~ ۲۵۰۰ ml ,OFF
VTIDAL LOW	۰ ml ~ ۲۵۰۰ ml
PEEP HIGH	۶ cmH_2O ~ ۴۵ cmH_2O
PEEP LOW	۰ cmH_2O ~ ۷ cmH_2O
O_2 HIGH	۱% ~ ۱۰۰%, OFF
O_2 LOW	۰% ~ ۱۰۰%
R-R HIGH	۳ ~ ۱۵۰ BPM
R-R LOW	۲ ~ ۱۴۹ BPM
VMIN HIGH	۰.۱ ~ ۵۰ LPM
VMIN LOW	۰ ~ ۴۹.۹ LPM
AIR FAIL	-
O_2 FAIL	-
AIR LEAK	۰ ml ~ ۵۰۰ ml
AIR OBST	-
APNEA	OFF, ۱۰ ~ ۶۰ sec
VENT INOP	-
O_2 SENSOR ERR	-
CIRCUIT OPEN	-
BATTERY MODE	-
LOW BATTERY	DC power loss
COM ERROR	

۱-۳-۴. Pneumatic Specifications

O_2 and air supply Pressure range	۳۵ ~ ۹۰ psi
	Flow ۱۵۰ L/min (STPD, dry required)
	۱۰۰ % O_2 Suction button– auto calibration
Oxygen sensor life	۱۰,۰۰۰ hours or ۱ Years of use, normal
Safety pressure Pneumatic	۳۰ psi +/- ۱۰ %
Internal pressure Limit	
Inspiration Pressure Limit	۸۵ cmH_2O +/- ۱۰% ;
	Mechanical release valve
Double safety mechanism for over pressure	

۱-۳-۵. Physical Data

Dimensions of device	۳۸ W x ۴۳ D x ۶۹ H cm
	(Width x depth x height of device)
Weight of device	۳۵ Kg (with Battery)
Dimensions of Cart	۴۹ W x ۵۶ D x ۷۷ H cm
	(Width x depth x height of device)
Weight of Cart	۲۸ kg
Connectors	
Inspiratory limb connector	ISO ۲۲mm conical male
Expiratory limb connector	ISO ۲۲mm conical male
Air and Oxygen inlets	DISS male / female

١-٣-٦. Environmental Data

Operating environment	Temperature : ١٠ to ٤٠ °C (٥٠ ~ ١٠٤°F)
Atmosphere	٧٠٠ to ١٠٦٠ mbar (١٠.٢ ~ ١٥.٤ psi)
Altitude	-٤٤٣ ~ ٣٢٨٠ m (-١٣٥٠ ~ ١٠,٠٠٠ ft)
Storage environment	
Temperature	-١٠ to ٦٠ °C
Relative humidity	١٠ to ٨٥ %
Atmosphere	٥٠٠ to ١٠٦٠ mbar (٧.٣ ~ ١٥.٤ psi)
Altitude	up to ٦٥٦٠ m (٢٠,٠٠٠ ft)
Oxygen/Air inlet supply pressure	٣٥ ~ ٩٠ psi

١-٤. Standard and Safety requirements

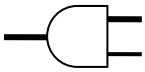
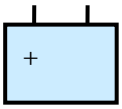
MEKANT is in conformity with the following tables. Obtainment of license and required testing has been completed.

EN٦٠٦٠١-١:١٩٩٠	General requirements for Safety
EN٦٠٦٠١-١-١:٢٠٠١	Electromechanical Safety
EN٦٠٦٠١-١-٢:٢٠٠١	Electromagnetic Compatibility Requirement and tests
IEC ٦٠٦٠١-٢-١٢:٢٠٠١	Particular requirements for the safety of lung ventilators for medical use

١-٥. Symbols and Labels

Descriptions for marking on MEKANT ventilator and its operational manuals.

No	Name	Symbol	Explanation
١	POWER ON/OFF		Provision of power by switching on and off the system. IEC ٦٠١-١
٢	Equipotential-ity		It is indicated terminal which do not need ground electric potential to make equipotential by connecting with each part of system or equipment. IEC٦٠١-١, IEC ٤١٧-٥٠٢١
٣	Attention, Consult accompanying documents		Indicates the necessity to refer to the operational manual prior to equipment operation. IEC ٦٠١-١
٤	stand-by		Indicates the stand-by mode of the system. IEC٤١٧-٥٠٠٩
٥	Start (of action)		Indicate the activation of the equipment. IEC ٤١٧-٥١٠٤
٦	Direct current		Indicates appropriateness for the equipment against direct current and designate the connecting part. IEC ٦٠١-١, IEC ٤١٧-٥٠٣١
٧	Battery check		Battery capacity indicator  FULL Charging  ٨٠% Charging  ٥٠% Charging  ٢٠% Charging  Low Charging

No	Name	Symbol	Explanation
٨	AC Power plug		Indicates the AC plug without ground earth. IEC ٤١٧-٥٥٣٤Pr
٩	Battery		It should be indicated rating sticker that equipment is suitable for only direct current (D.C). Also, indicate it is related connecting part. IEC ٦٠١-١, IEC ٤١٧-٥٠٣١
١٠	EXT. BATT	EXT. BATT	Indicates external battery for vehicle use.
١١	Manual control		Indicates manual operation of the apparatus. ISO٧٠٠٠-٠٠٩٦
١٢	CLEAR		Clears the menu tree from the display.
١٣	Dangerous voltage		Warns the high voltage. IEC٦٠١-١, IEC٤١٧-٥٠٣٦, ISO ٣٨٦٤
١٤	١٠٠% O_2 MODE	O_2 ١٠٠%	Indicate ١٠٠% O_2 MODE. This mode can by ON / OFF by O_2 ١٠٠% KEY
١٥	NEBULIZER MODE		Indicate NEBULIZER MODE. This mode can be ON / OFF by NEBULIZER KEY, and the operating time is set from 10 to 180 minutes.
١٦	MANUAL INSPIRATION KEY	MANUAL	Supply the respiration to the patient when pressing the MANUAL INSPIRATION KEY.

No	Name	Symbol	Explanation
١٧	INSPIRATION HOLD		Increase INSPIRATION TIME to ١ second.
١٨	EXPIRATION HOLD		Increase EXPIRATION TIME to 2 second.
١٩	ALARM SOUND OFF Or MUTE		Indicate ALARM SOUND OFF or MUTE. This function can be ON / OFF by pressing ٢ MIN KEY.

Table 1-5. Description of Symbols

١-٦. Maintenance

The following table shows the periodic check point and maintenance method for MEKANT ventilator system and the circuit system.

Period	Subject	Check point
Daily	Bacteria Filters - Inspiratory Filter - Expiratory Filter	Check if all filters are in good position.
	Patient Circuit System	Check the connection, leakage, Blockage and moisture.
	Collector Vial, Gas Supply Water Traps	Check if there is moisture and remove it if necessary.
Minimum Every half month or when changed the patient	Patient Circuit System, all Bacteria Filters and Humidification Chamber	Exchange everything, and cleaning and sterilizing used one.
Every Half year	All system	Conduct EST
Every year or After ١٠٠ times autoclaving	All Bacteria Filters	Exchange to new filter and scrap used one
Between ١ year and ٢ year	Oxygen Sensor	Exchange to new one
When necessary	Oxygen Sensor	Conduct Oxygen sensor calibration by pressing ١٠٠% O٢/CAL.
Every ١٠,٠٠٠ hours	Various components	Exchange appropriate components using ١٠,٠٠٠ hours PM kit.

Table 1-6. Check and Maintenance Period

Caution

User should check the installation status and problem of the filters and patient circuit system with naked eyes every day. In case of any problem, replace or exchange the parts in problem right away.

When patient is changed or one patient uses it for a long period, exchange the patient circuit system including bacteria filter in every ١٥ days, and clean and sterilize the used one.

All the components of patient circuit system excluding bacteria filter can be sterilized by any way among ETO(Ethylene Oxide) gas sterilization, Steam Autoclave and Chemical sterilization. But, only Steam Autoclave is available for bacteria filter.

Sterilization shall be done for about ٢٠ minutes at ١٣٢ degree centigrade. Exchange to new bacteria filter after one year use or ١٠٠ times of Autoclave use.

Oxygen sensor is valid for ٢ years, but it can be shortened in case of using at the condition of high $FiO_٢$ or high temperature.

Section ٢ : Installation and set up ٢٣
٢-١. Installation ٢٣
٢-٢. External electrical supply ٢٣
٢-٢-١. AC description ٢٣
٢-٢-٢. External battery ٢٥
٢-٣. Internal battery ٢٦
٢-٣-١. Internal battery Indicator ٢٧
٢-٣-٢. How to change internal battery ٢٨
٢-٤. Oxygen and Air supply ٢٩
٢-٥. Filters ٣٠
٢-٦. Transportation ٣١
٢-٧. Fuse replacement instruction ٣٢

Section ٢ : INSTALLATION AND SET UP

٢-١. Installation

When installing and moving the equipment, it is required to stay shock free.

٢-٢. External electrical supply

MEKANT is capable to receive both AC and DC power supply.

٢-٢-١. AC description

External AC connector is located on the rear side of the apparatus.

Refer to Figure ٢-١.

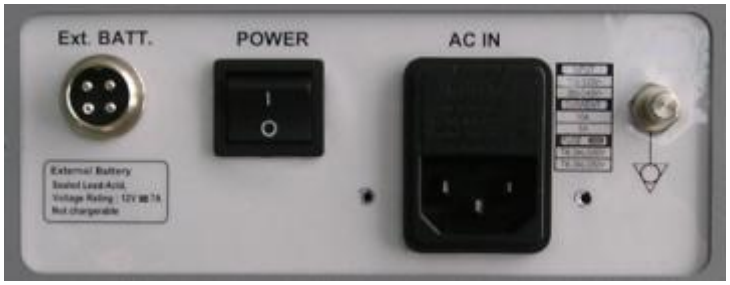


Figure ٢-١. External AC and DC Power Supply Sockets

Warning

Prior to applying AC or DC to the ventilator, the line frequency has to be adjusted to the local standard otherwise it might cause damages to the apparatus.

Power Cord has to be plugged in to the concentric plug on the ground.

Replace covered wire in case of wear and tear.

Please apply the ground cable in order to protect the patient and the apparatus.

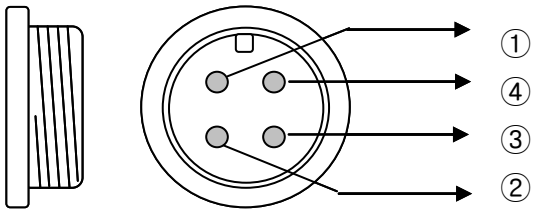
Maintain the same level of input & output voltage.

Caution

Cable Clips are used in order to affix the AC code and also to prevent disconnection.

When connected to DC or AC, LED display will be turned on to indicate the connection.

٢-٢-٢. External battery



Pin	Name	Direction	Explanation
①	Not connected		Not used
②	GND	▬	Pins for the ground.
③	+VCC	◀	Pins to connect external battery
④	Not connected		Not used

Table ٢-٢. Pin Setting of MV٢٠٥٠ Ventilator External Battery

Warning

Watch for polarity when connecting the battery.

Note that when external battery is used, internal battery will not be charged.

It should be used for rating voltage, ١٢V⎓ 7A and Electric current should be more than ١A.

Caution

Cover the Port Pin by putting the cap when the external battery is not in use.

Do not make pin to be shorted because internal Battery is damaged when EXT. BATT is opened, or each pin is shorted.

Please put a cap next to terminal when EXT. BATT is not used.

NOTE :

Fuse is built in the machine.

ATO® Fuse (Fast-Acting Type), Catalog Number ٢٥٧ ٠١٥, Ampere Rating (A) ٥A, Body color code : blue

Vehicle outlet power supply is used.

٢-٣. Internal battery

Internal battery for MV ٢0٠٠ is used for the provision of power when moving the patients. Recharge of the battery is done while AC power connected as the apparatus simultaneously utilizes the power from the same source of AC. In case of power failure, the operation will be done by internal battery.

Warning

When replacing the battery, watch for polarity. Red for +, Black for -. Inappropriate connection might cause damages to the apparatus.

Short-circuit might cause explosion of the battery or harm human body due to high voltage.

It should be used for rating voltage, ١٢V ⎓ 7A and Electric current should be more than ١A.

We recommend that you should contact the distributor or CS team if you find any problems in the internal battery.

Caution

When difficulties of power supply arise or when transferring the patients, the battery needs to be charged. Replace the battery if it is in deficiency.

In case of the lowest battery voltage, there may be an error in the measured value.

In case of low battery, use the machine after connection to AC common electric power.

NOTE :

Fuse is built in the machine.

ATO® Fuse (Fast-Acting Type), Catalog Number ٢٥٧ ٠١٥, Ampere Rating (A) ٥A, Body color code : blue

Internal Battery may be affected by the number of times for discharge, surrounding temperature, charging voltage. Generally it can be used more than ٢ years.

٢-٣-١. Internal battery indicator

It displays battery capability. This is displayed on the upper right hand corner of the LCD display. The battery capacity will be displayed in ٥ main statuses.

Battery Indicator	Level Status	Explanation
	Full Charging	
	٨٠% Charging	
	٥٠% Charging	
	٢٠% Charging	
 	Low Charging	In case of discharging status, the system will be automatically turn off to protect the battery ٥ minutes later.

Table ٢-3-1. Internal battery Indicator

٢-٣-٢. How to change internal battery

No.	Figure	Explanation
ⓐ		Unscrew ٤ screws on the lower rear cover that is for Battery
ⓑ		You can see the internal battery. After changing battery, assemble the battery cover.

Table ٢-3-2. How to change internal battery

Warning

When replacing the battery, watch for polarity.

Red for +. Black for −.

Inappropriate connection might cause damages to the apparatus. Short-circuit might cause explosion of the battery or harm human body due to high voltage.

Caution

All of bolt is locked when turned clockwise. All of bolt is loosed when turned counter clockwise.

٢-٤. Oxygen and Air supply

MEKANT is the system to provide oxygen and air to patients. Oxygen and Air are provided through the adaptor end at the rear by pressure (٣٥ ~ ٩٠ PSI) and get mixed to have appropriate concentration.

No.	Figure	Explanation
ⓐ		١. O٢ consists of green adaptor and green high pressure hose. ٢. Air input consists of a yellow color.

Table ٢-4. Connection way of high pressure hose

Warning

Check the oxygen and air connector to be free from oil to prevent from explosion.

When you supply or stop oxygen and air, be careful when it's assembled and disassembled because high pressure hose can harm to human body due to inside pressure.

Caution

Check and see if the Oxygen and Air pressure is set at exact pressure range prior to ventilator application.

When high pressure hose is used or moved, pay attention to wiring not to be tripped over persons.

٢-٥. Filters

Use ٢ filters between MEKANT Product and patient for the safety of patients. Before supplying for patient INS. Filter is used, and exhalation filter is used at the place for exhaled air from patient's body in order not to supply polluted air to patient.

Warning

Contaminated gas might be in exposure to patients if the air was provided without applying filter.

Do not reuse the accessories when ⊗ symbol is found since it represents its category as disposable.

Replace the disposable sensor with the new one after single use.

Reusable materials which are used for patients shall be sterilized and washed for reuse.

Caution

Filters must be MEKICS genuine or designated products. If you wish to use other makes, please consult biomedical engineers at the hospitals, or local authorized dealer.

Please use quality certified product, otherwise manufacturer will not be responsible for any problems caused by this.

All accessories are aseptic; therefore the wrapping has to be intact before opening and use.

٢-٦. Transportation

No.	Figure	Explanation
ⓐ		١. Move the product by handle.

Table ٢-6. Handle of the Cart

Warning

When moving the apparatus, please make sure that the LCD Monitor is fixed properly since this might cause damage to the Device.

Please move the product when components and power cords are in order.

Caution

Before moving the system, unlock the locker on the caster.

٢-٧. Fuse replacement instruction

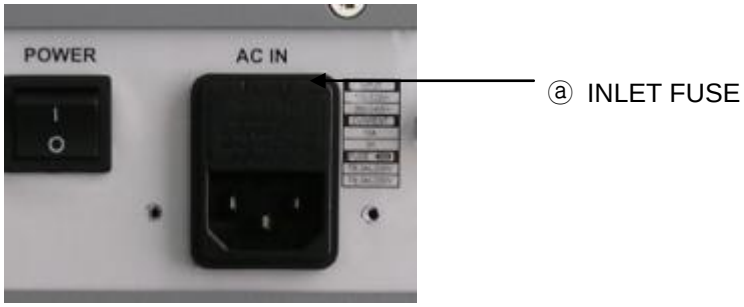


Figure ٢-٥. AC INLET FUSE

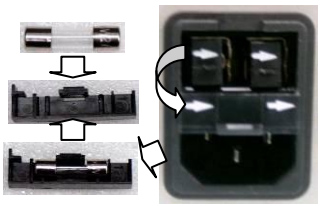
No.	Name	Figure	Explanation
ⓐ	INLET FUSE		١. Pull the upper part of inlet toward you. ٢. Fuses are located where two upper arrows are and those are and those lower ٢ arrows indicate the direction when inserted. ٣. Remove the existing fuse and insert the new fuse as shown in the picture after checking the rating. ٤. Close the inlet by doing the steps backward.

Table ٢-٣. How to change fuse

Section ٣ : Operating instructions ٣٥

٣-١. Front panel ٣٥

٣-١-١. Rotational Control Knob ٣٥

٣-١-٢. Keypad ٣٦

٣-١-٣. LED Indicators ٣٧

٣-٢. Operating ٣٧

٣-٢-١. Operating procedure and how to use ٣٧

٣-٣. Display ٤٠

٣-٣-١. Status information ٤١

٣-٣-٢. Waveform and alarm status ٤٢

٣-٣-٣. Menu and setting information ٤٣

٣-٣-٤. TOUCH information ٤٤

٣-٣-٤-١. VENT TOUCH screen ٤٥

٣-٣-٤-٢. Waveform screen ٤٦

٣-٣-٤-٣. Menu screen ٤٧

٣-٣-٤-٤. Setting screen ٤٨

٣-٤. Start MV٢٠٠٠ ..... ٤٩

٣-٤-١. VENT MODE ٥٠

٣-٤-١-١. VACV ٥١

٣-٤-١-٢. VSIMV ٥٣

٣-٤-١-٣. PACV ٥٦

٣-٤-١-٤. PSIMV ٥٨

٣-٤-١-٥. SPONT ٦١

٣-٤-١-٦. tBILEVEL ٦٣

٣-٤-١-٧. NIV ٦٦

٣-٤-١-٨. PRVC ٦٨

٣-٤-١-٩. AUTO ٧١

٣-٤-٢. Monitoring ٧٢

٣-٤-٣. Graphics ٧٣

٣-٤-٤. Tools ٧٦

٣-٤-٥. Events ٧٧

٣-٤-٦. SYSTEM ٧٨

٣-٤-٦-١. SETUP ٧٨

٣-٤-٦-١-١. BWF ٧٩

٣-٤-٦-١-٢. Nebu. Time ٧٩

٣-٤-٦-١-٣. O٢ SENSOR ٧٩

٣-٤-٦-١-٤. Trend Init. ٧٩

٣-٤-٦-١-٥. BTPS ٨٠

٣-٤-٦-١-٦. Sound Vol. ٨٠

٣-٤-٦-١-٧. Altitude ٨٠

٣-٤-٦-١-٨. Air Temp. ٨٠

٣-٤-٦-٢. PATIENT ٨١

٣-٤-٦-٣. Date ٨٢

٣-٤-٦-٤. Calibration ٨٣

٣-٤-٦-٤-١. SELF CALIBRATION ٨٤

٣-٤-٦-٤-٢. O٢ CALIBRATION ٨٤

٣-٤-٦-٤-٣. INS-EXP CALIBRATION ٨٤

٣-٤-٦-٤-٤. EtCO٢ CALIBRATION ٨٥

٣-٤-٧. ALARM SET ٨٦

Section ٣ : Operating instructions

٣-١. Front panel

٣-١-١. Rotational control knob

Rotating and Pressing the Encoder allows a user to navigate through and make changes to the display element.

Left Rotating
- Menu Down
- Left Value

Right Rotating
- Menu Up
- Right Value

Click
- Menu confirmation & storing

Figure 3-1. Encoder

٣-١-٢ Keypad

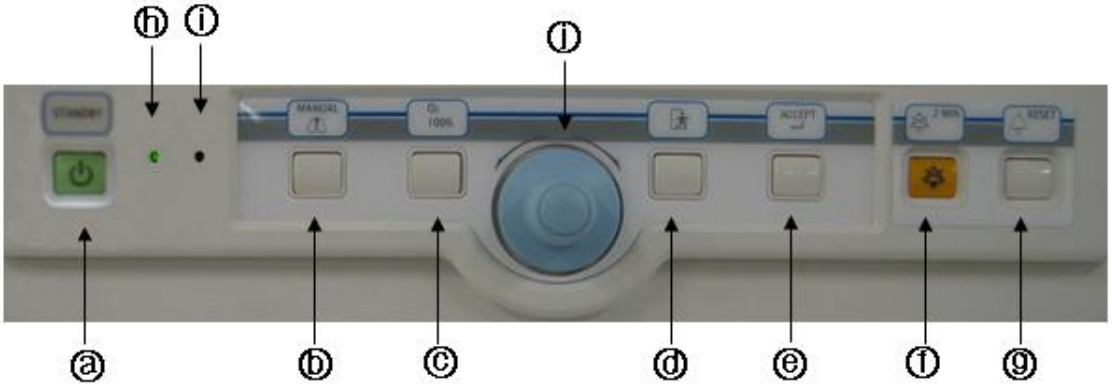
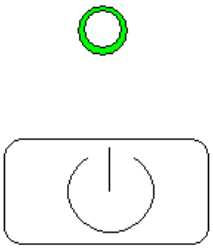


Figure ٣-1-2. Keypad

Part Number	Picture	Description
ⓐ		**Start Switch, Standby** ١) If you press START switch for 0.5 sec, power would be on. In case of STOP OFF you want, switch should be pressed for longer than 10 seconds in Vent operating. ٢) Switch should be pressed for longer than 5 seconds in Vent Ready status. ٣) In case of STANDBY you want, switch should be pressed in Vent operating.
ⓑ	**MANUAL INSPIRATION**	**MANUAL INSPIRATION**: This function which is for a respiration according to Ventilator's default is operated once by pressing the key.
ⓒ	**100% O_2**	١٠٠% **O_2** : If you press this button, ١٠٠% O_2 is provided for 3 minutes.
ⓓ	**CLEAR** 	**CLEAR** : It is used for clearance of menu when menu is controlled by Knob

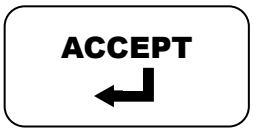
Part Number	Picture	Description
ⓔ		**ACCEPT RUN** : It is used when Ventilator is working as its final value. If ACCEPT key is not pressed, setting value would not be accepted on the change of MODE and VENT SETTING. This is for the safe.
ⓕ		**ALARM ٢ MIN** : This makes ALARM remove for ٢ minutes.
ⓖ		**ALARM RESET** : This actives when alarm is reset. And previous alarm lamp is removed and the status of NORMAL will be.
ⓙ		**Encoder** : Rotary switch for selecting function on the pop-up menu.

Table ٣-١-٢. Keypad

٣-١-٣. LED Indicators

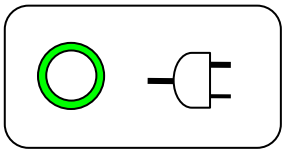
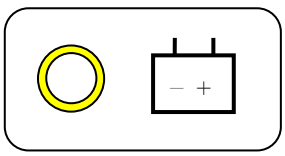
Part Number	Picture	Description
ⓗ		**AC POWER ON LED** : LED is on when machine is connected to AC, otherwise, LED is OFF.
ⓘ		**BATTERY ON LED** : Battery is charged as the machine is working when it is connected AC If it is not, battery ON LED is lighted because the machine is operating by internal battery. If both AC POWER ON LED and BATTERY ON LED are OFF, battery should be charged.

Table ٣-١-3. LED Indicators

٣-٢. Operating

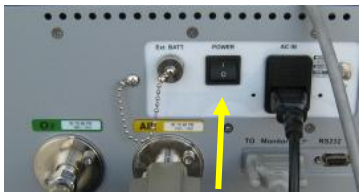
Caution

Buzzer will be sounded when main power is on normally. Otherwise, check something wrong on the main power. (power, battery, fuse)

ALARM LAMP (Warning or INOP) is on and buzzer is sounded if ventilator has defect on working .

Connect the ventilator to the power is earthed.

٣-٢-١. Operating procedure and how to use

No.	Picture	Description
١		١) Connect high pressure hose and accessories.
٢		١) Connect earthed cable to equipotential port and earthed AC power. ٢) Connect power cord to an electric outlet and AC inlet. ٣) Switch on POWER on the back side.

٣		١) Switch on START on the Front Panel. System Fail sound will be disappeared in case power is on normally. *2)* Wait for the calibration of each sensor. It is presented normal INITIAL, and then normal ventilator READY is appeared.
٤		١) Set the present time and date.. (In an emergency, can be omitted.) ٢) Enter patient's bed number etc. (In an emergency, can be omitted.) ٣) In Standby Screen, Select patient's ages and input patient's height. Press START button. ٤) In top right corner, press Modes button and Choose mode suitable for the patient. Input other value as prescription. Adjust value by pressing and rotating. ٥) Select ACCEPT button. ٦) Adjust alarms properly. ٧) Check the wave form and figure on the monitor normally.

Figure ٣-2-1. Operating procedure and how to use

٣-٣. Display

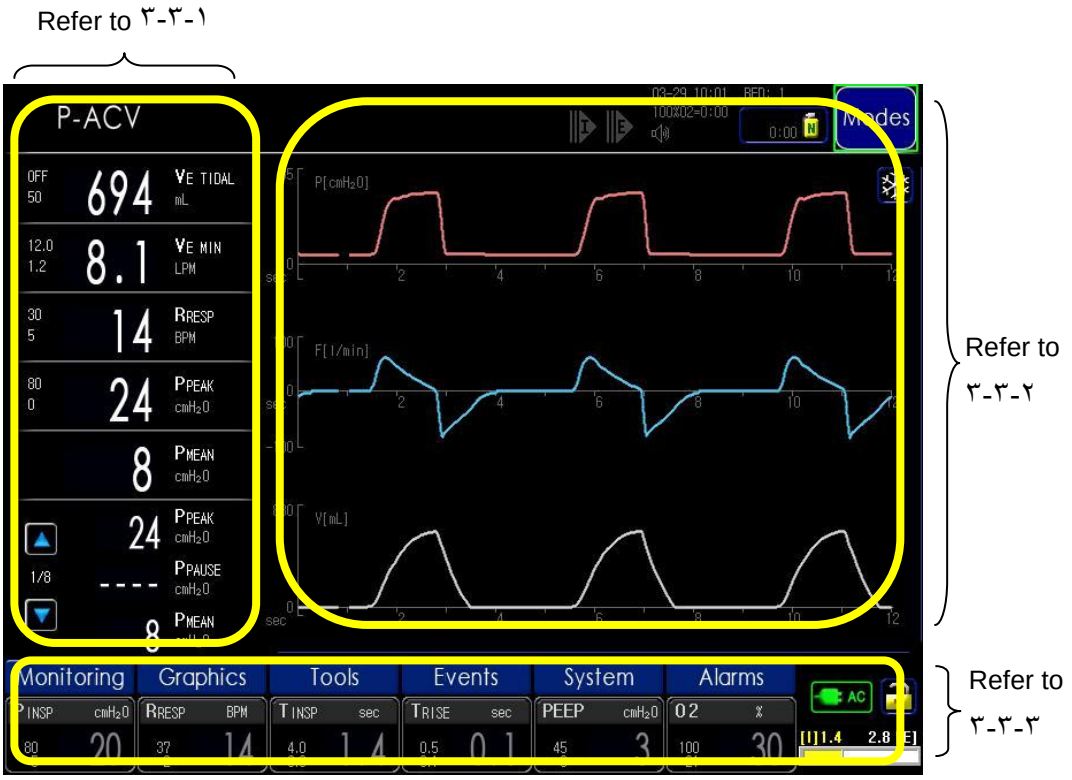


Figure ٣-3. LCD Display

Explanation		Reference
Measurement information	Measurement of ventilator or patient factor.	٣-٣-١
Waveform and alarm status	Graph and alarm statue of ventilator or patient factor.	٣-٣-٢
Menu and Setting information	Menu button and Setting value according to respiratory mode.	٣-٣-٣

Table ٣-3. Description of display explanation

٣-٣-١. Status and measurement information

It displays measurement information of ventilator or patient factor. It shows different tables of measurement information to each Mode. By default, $V_{E\ TIDAL}$, $V_{E\ MIN}$, R_{RESP}, P_{PEAK} and P_{MEAN} be displayed. Press  buttons in bottom left of the screen. It can be change different values.

Measurement items are displayed by the page as follows.

Page number	Displayed items
١	PPEAK, PPAUSE, PMEAN
٢	PEEP, AutoPEEP, P ٠.١
٣	VI TIDAL, VE TIDAL, VE MIN
٤	PEEPH, PEEPL, FPEAK
٥	RRESP, RRSPONT, VEMIN SPONT
٦	TI, TE, I : E
٧	EXP.FLOW, RSBi, O٢
٨	CL, RA
٩	HR, SpO٢
١٠	EtCO٢, Ins, RRESP

Table ٣-٣-١. Displayed items by the page

Displayed status can be confirmed in Monitoring Menu overall. If you want more information, refer to [٣-٤-٢. Monitoring].

٣-٣-٢. Waveform and alarm status

It displays WAVE, ALARM STATUS and MESSAGE to ventilator or patient factor. Refer to Section ٤ for alarm information.

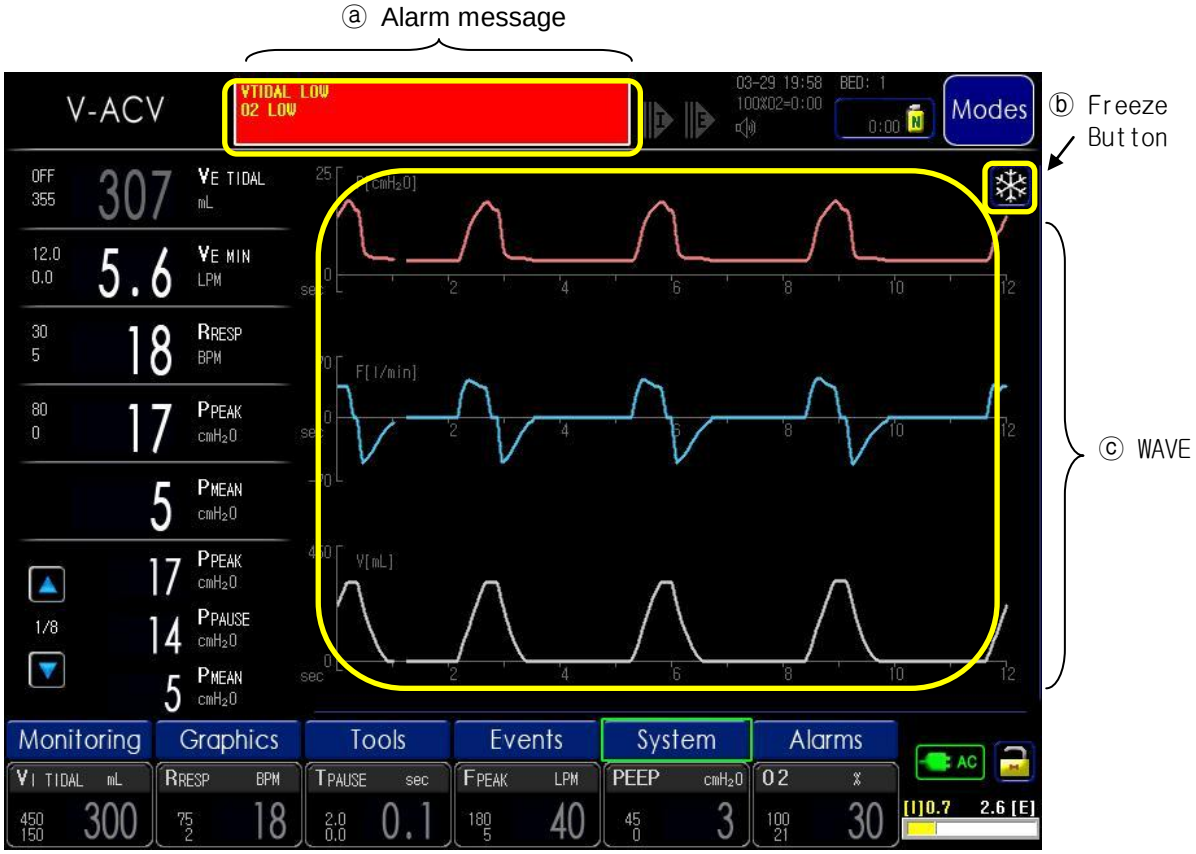


Figure ٣-3-2. Waveform, Freeze and Alarm status

Part Number	Display	Explanation
ⓐ	Alarm message	It displays alarm message. Refer to Section ٤ for alarm information.
ⓑ	Freeze button	If press Freeze button, measurement keep going but display stop. Press Freeze button again, display start again.
ⓒ	WAVE	It displays waveforms of Pressure, Flow, Volume, SpO_2(Option), $EtCO_2$(Option), P-V. V-F, P-F graph and Trend graph. Refer to [٣-٤-٣. Graphics] for alarm information.

Table ٣-٣-2. Waveform and alarm status explanation

٣-٣-٣. Menu and Setting information

It displays respiratory mode of VENT Mode. It shows different table of setting table to each Mode.

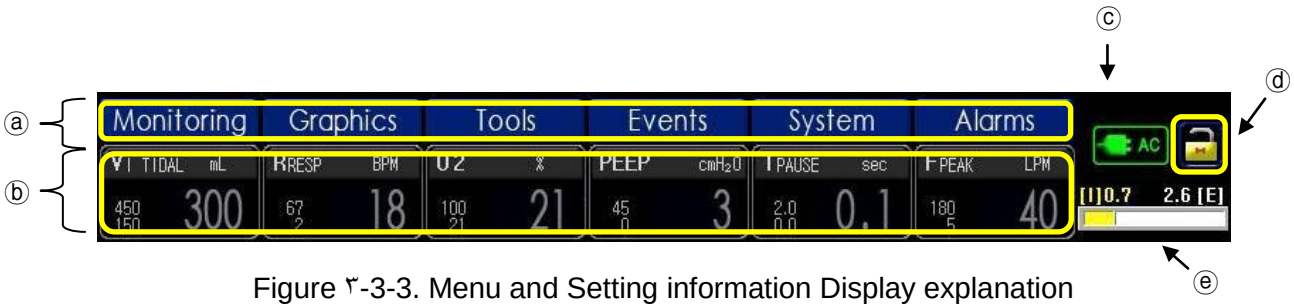


Figure ٣-3-3. Menu and Setting information Display explanation

Part Number	Display	Explanation
ⓐ	Menu	Refer to [٣-٣-٤-٣. Menu Screen]
ⓑ	Setting information	Refer to [٣-٣-٤-٤. SETTING TOUCH]
ⓒ		It displays AC Power. (It maybe changed Battery Status)
ⓓ		TOUCH ON/OFF
ⓔ		It displays ratio of I:E

Table ٣-3-3. Setting information Display explanation

٣-٣-٤. TOUCH SCREEN

MV ٢٥٠٠(Touch) can be operated by screen touch. It displays the Touch Area on screen. It is possible to touch the area within outlined area.

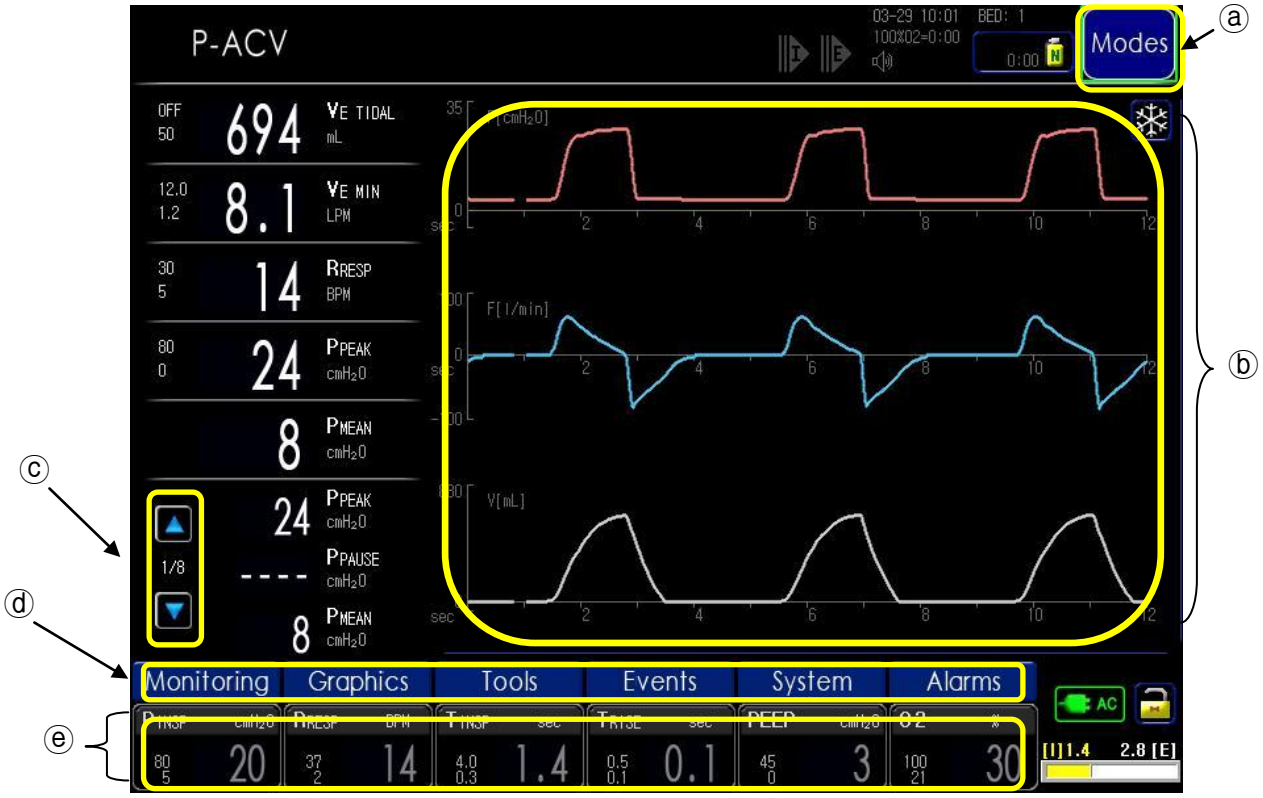


Figure ٣-٣-٤. TOUCH Screen information

Part Number	Display	Explanation	Ref.
ⓐ	VENT TOUCH	Select to change the vent mode.	٣-٣-٤-١
ⓑ	Waveform	If you TOUCH waveform screen, the waveform can be converted to other waveforms.	٣-٣-٤-٢
ⓒ	Status information	Can be change different values. Refer to [٣-٣-١. Status information]	-
ⓓ	Menu	Select to change the menu setting with touch.	٣-٣-٤-٣
ⓔ	Setting screen	During vent mode operating, you can change the vent setting value.	٣-٣-٤-٤

Table ٣-٣-٤. TOUCH Screen information explanation

٣-٣-٤-١. VENT TOUCH SCREEN

You can go directly to the breathing mode settings in [VENT] TOUCH area

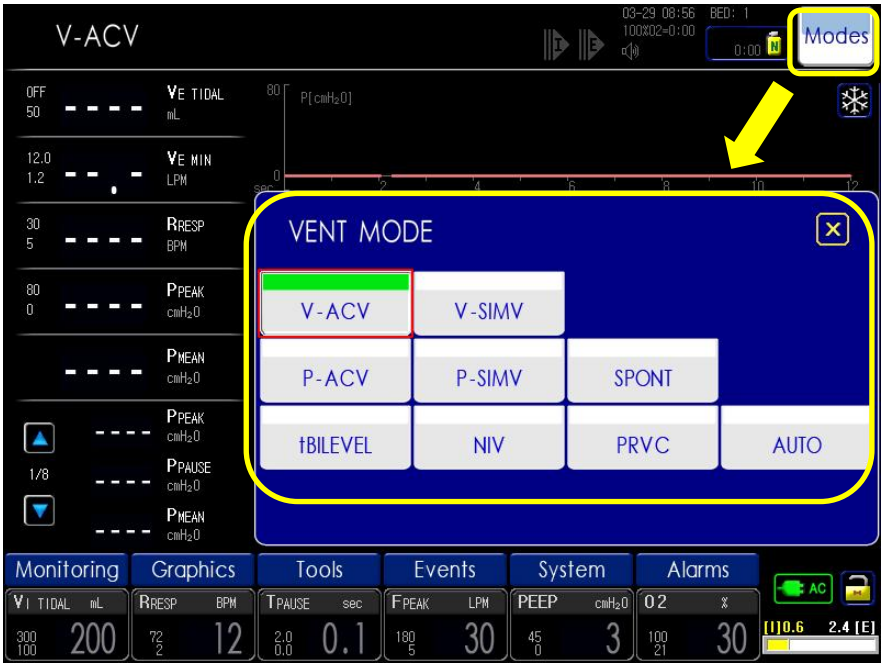


Figure ٣-٣-٤-١(١). VENT MODE SETTING SCREEN

If you choose VENT MODE, the following screen will appear. After entering the setting, touch [ACCEPT] button, chosen mode will start. Refer to [٣-٤. MV٢٠٠٠ Start]

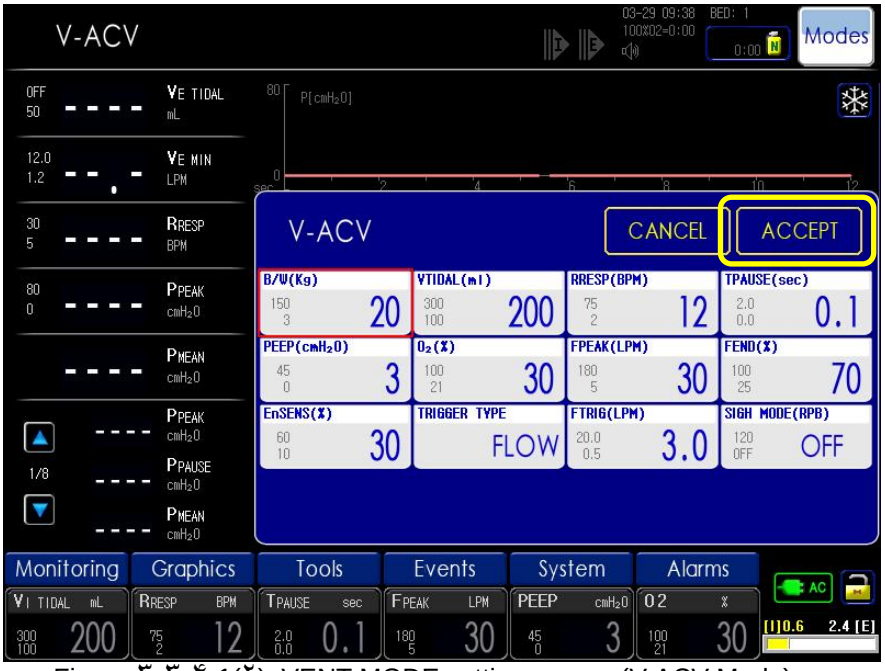


Figure ٣-٣-٤-1(٢). VENT MODE setting screen (V-ACV Mode)

٣-٣-٤-٢. Waveform screen

The border area is the waveform screen

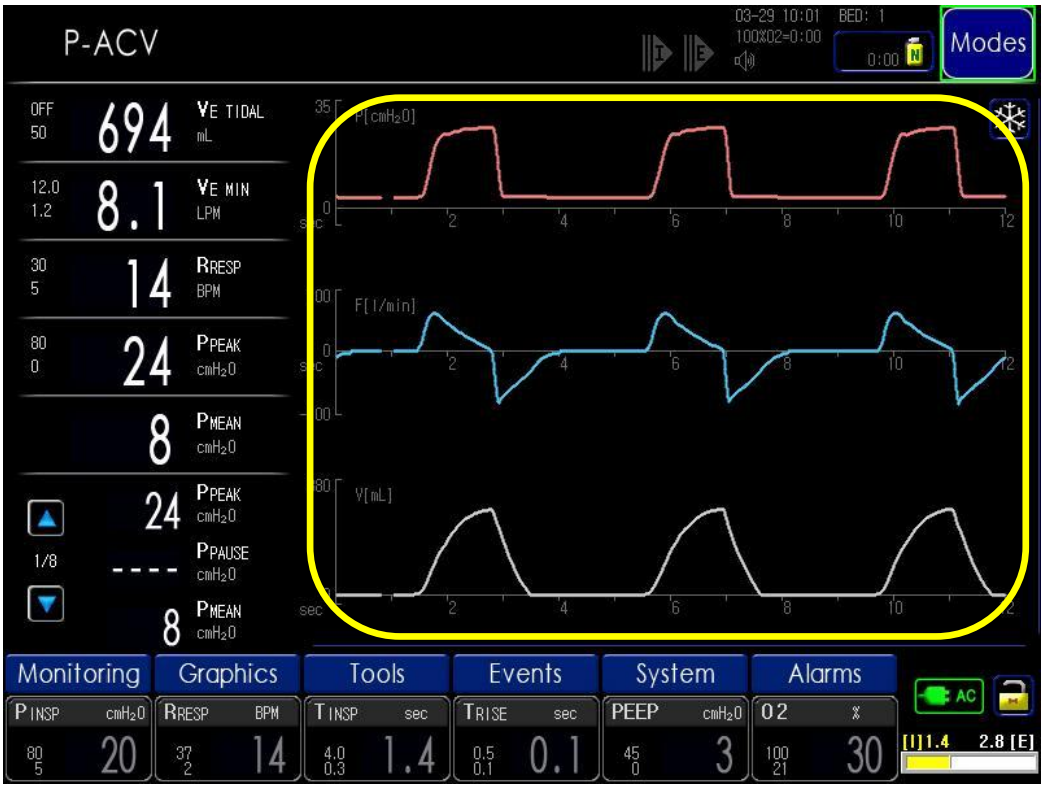


Figure ٣-٣-٤-٢. Waveform screen information

If you TOUCH waveform screen, you can be change the measured graph.

Refer to [٣-٤-٣. Graphics]

٣-٣-٤-٣. MENU SCREEN

As follow; TOUCH Menu screen or use encoder, for each menu screen appears.

Figure ٣-٣-٤-٣. MENU SCREEN information

For a description of each menu are as follows.

Part Number	Explanation	Ref.
Monitoring	Overall, the measured data shows for each mode.	٣-٤-٢
Graphics	Can set Screen Layout and Trend Timing.	٣-٤-٣
Tools	Use Insp. hold and Exp. hold.	٣-٤-٤
Events	Can check Event occurred.	٣-٤-٥
System	Setup preferences, patient information, date modified, calibration settings are configured.	٣-٤-٦
Alarms	Set the alarms.	٣-٤-٧

Table ٣-٣-٤-٣. MENU SCREEN explanation

٣-٣-٤-٤. SETTING screen

In breathing mode of operation, you can select the area of the SETTING screen (figure ٣-٣-4-3) and change the vent variable. If you re-click that variable, change the breathing variable that is applied immediately.

Figure ٣-٣-٤-٣. SETTING TOUCH screen information (V-ACV mode)

Also, depending on the operating mode automatically changes SETTING screens.

VENT MODE	SETTING screen list
V-ACV	V Tidal, R RESP, T PAUSE, F PEAK, PEEP, O ٢
V-SIMV	V Tidal, R RESP, T PAUSE, F PEAK, PEEP, O ٢
P-ACV	P INSP, R RESP, T INSP, T RISE, PEEP, O ٢
P-SIMV	P INSP, R RESP, T INSP, T RISE, PEEP, O ٢
SPONT	P SUPP, T RISE, APNEA, T RIG, PEEP, O ٢
tBiLEVEL	P SUPP, R RESP, TH PEEP, PEEP H, PEEP L, O ٢
NIV	P INSP, R RESP, T INSP, T RIG, PEEP, O ٢
PRVC	V Tidal, R RESP, T INSP, T RIG, PEEP, O ٢
AUTO	P INSP, R RESP, T INSP, T RIG, PEEP, O ٢

Table ٣-٣-٤-٣. SETTING screen explanation

٣-٤. Start MV ٢0 ٠٠

To start MV2000, select the patient's condition and enter the patient's height in the Standby screen, and press START button to begin. Press Modes button in the top right corner to set the VENT mode. Also TOUCH ⓐ area, move immediately to selected mode setting screen.

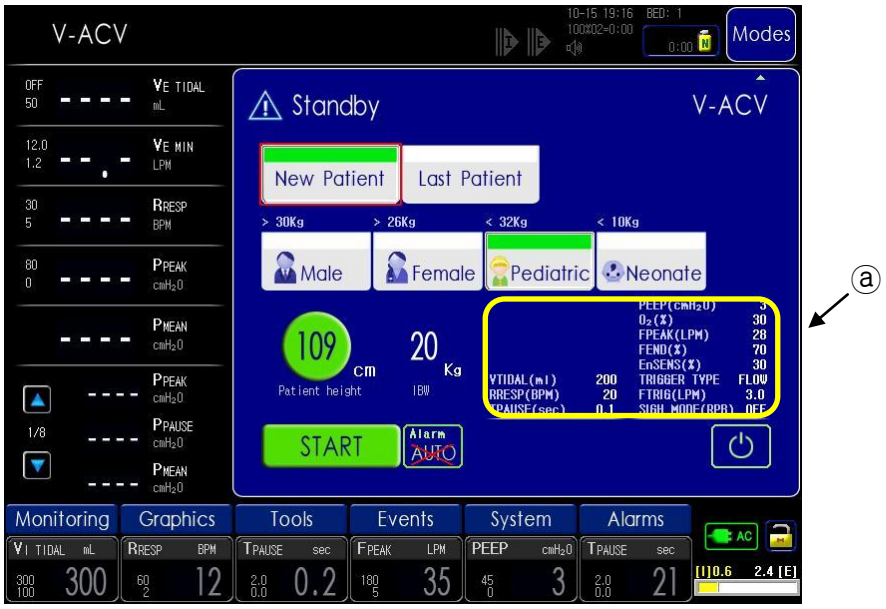


Figure ٣-٤. Standby screen

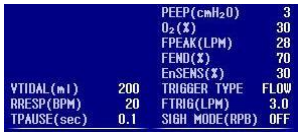
Explanation	
	Add a new patient or load Recently the patient setting.
	If the patient's height decisions, according to age and gender will automatically calculate IBW.(Ideal Body Weight).
	Move immediately to selected mode setting screen.
	If you enable Alarm AUTO, Start button is automatically set by the Alarm.
	Start MV2000.
	Power off MV2000.

Table ٣-٤. Standby screen explanation

٣-٤-١. VENT MODE

MV ٢٥٠٠ has the ventilation mode which are SIMV(VSIMV,PSIMV), ACV(VACV, PACV, other company calls CMV to Mandatory Mode), Spontaneous Mode, tBi-Level, NIV, PRVC and AUTO Mode.

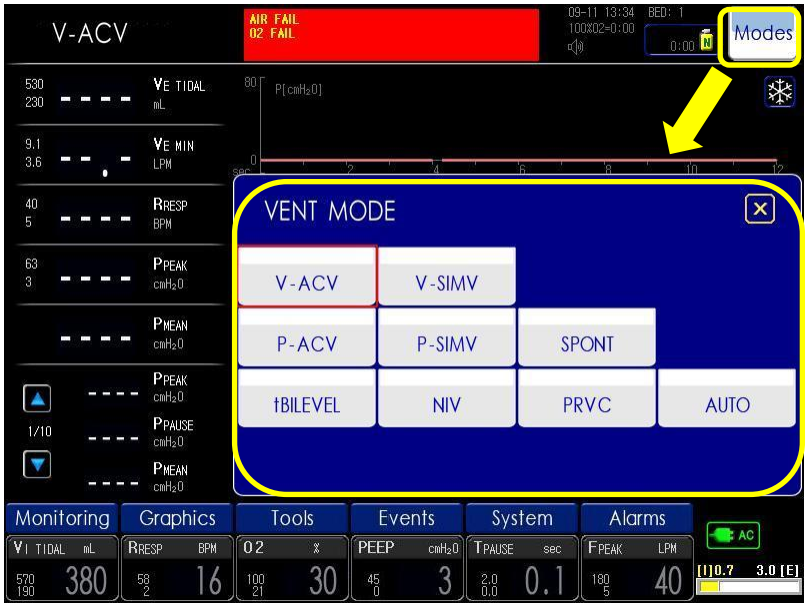


Figure ٣-٤-١. VENT MODE menu

VENT MODE	Operating MODE	Explanation	Ref.
V-ACV	V-ACV	Volume based Assistance Controlled Ventilation It controls Patient Ventilation by force from air volume. And it controls expiration time and inspiration time by force.	٣-٤-١-١
V-SIMV	V-SIMV	Volume based Synchronized Intermittent Mandatory Ventilation. It controls Patient Ventilation to air volume from Synchronized Intermittent Mandatory Ventilation	٣-٤-١-٢
P-ACV	P-ACV	Pressure based Assistance Controlled Ventilation It controls Patient Ventilation by force from air pressure.	٣-٤-١-٣
P-SIMV	P-SIMV	Pressure based Synchronized Intermittent Mandatory It controls Patient Ventilation to air pressure from Synchronized Intermittent Mandatory Ventilation.	٣-٤-١-٤
SPONT	SPONT	Spontaneous Ventilation. It supports spontaneous breathing.	٣-٤-١-٥
tBiLEVEL	tBiLEVEL	It is same to SPONT. And it has Upper PEEP. (Refer to SPONT)	٣-٤-١-٦
NIV	NIV	Non Invasive Ventilation It is mask type, not tubing type. It work P-ACV allow to leakage. (Refer to P-ACV)	٣-٤-١-٧
PRVC	PRVC	Pressure Regulated Volume Controlled Ventilation Breath are delivered mandatorily with a constant flow to assure present volumes.	٣-٤-١-٨
AUTO	P-ACV	Quick Start according to the weight of patient. (P-ACV Controlled)	٣-٤-١-٩

Figure ٣-٤-١. VENT MODE menu explanation

٣-٤-١-١. V_{ACV}

V_{ACV} (Volume based Assistance Controlled Ventilation) :

It controls Patient Ventilation by force from tidal volume. And it controls expiration time and inspiration time by force. VITIDAL means inspiration volume to supply patient.

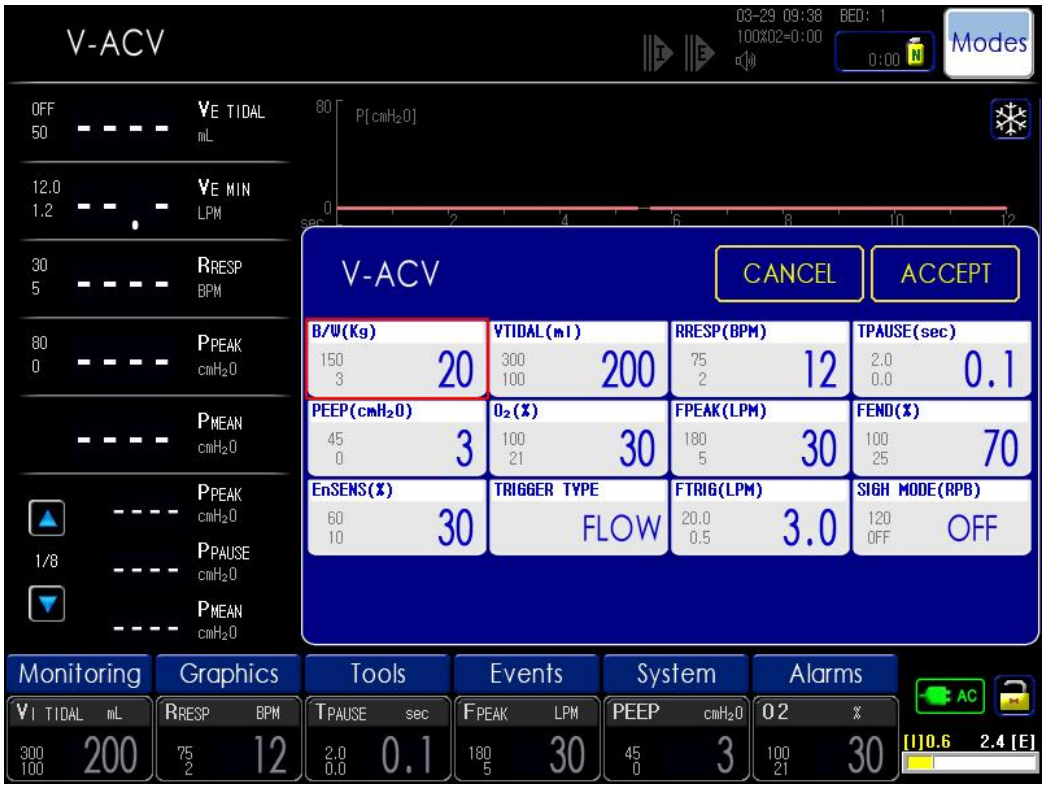


Figure ٣-٤-١-١. V-ACV SETTING screen

Item	Setting Range	Unit	Step	Explanation
V_{TIDAL}	٥ ~ ٢٥٠٠	mL	٥	It decides volume of ١ breath. **NOTE :** It set the volume of patient weight. It is ١٠mL per ١kg. (You can set the volume per 1kg in [SYSTEM - SETUP - BWF] Menu.)
R_{RESP}	٢ ~ ١٢٠	BPM	١	It set the respiratory rate per ١ minute.
T_{PAUSE}	٠.٠ ~ ٢.٠	sec	٠.١	Inspiration Pause Time. It set the inspiration pause time.
P_{EEP}	٠ ~ ٤٥	cmH_2O	١	It set the PEEP pressure.(Base pressure of patient)
O_2	٢١ ~ ١٠٠	%	١	It set the percent of O_2 to patient.
F_{PEAK}	٥ ~ ١٨٠	LPM	١	It set the flow-peak (maximum velocity) to patient.
F_{END}	٢٥ ~ ١٠٠	%	٥	It set percent of Flow (supply velocity) / Fpeak (supply maximum velocity) to End-tidal.
E_{nSENS}	١٠ ~ ٦٠	%	١٠	It set the sensitivity of one breath completion of patient during to setting of percent of patient expiration volume.
TRIGGER TYPE	PRESSURE /FLOW	-	-	It sets the type of trigger. It is Pressure or Flow type.
$F(P)_{TRIG}$	٠.٥ ~ ٢٠	cmH_2O /LPM	٠.٥	Setting to detect spontaneous breathing signal, There are pressure and Flow type. User can select one.
S_{IGH} MODE	OFF, ٣٠, ٦٠, ٩٠, ١٢٠	RPB	٣٠	It sets breathing rate timing in sigh mode. Don't support over ١٥٠٠mL volume.
ACCEPT	-	-	-	Execute V-ACV Mode.
CANCEL	-	-	-	Go back to previous menu

Table ٣-٤-١-١. V-ACV SETTING screen explanation

A/C (Volume Control) - V-ACV

If MEKANT perceives spontaneous breathing it works the Assisted Mandatory Breath. If not it works Controlled Mandatory Breath.

When MEKANT works in Volume Control Ventilation it decides inspiratory time for setting of tidal volume and peak flow. Also inspiratory time is influenced by flow pattern and plateau.

In the case of I:E ratio decides it for factor of inspiratory time and respiratory rate.
When you change the factor of I:E ratio and inspiratory time, you can know cycle time, inspiratory time, expiratory time and I:E ratio through breath timing bar.

٣-٤-١-٢. V_{SIMV}

V_{SIMV} (Volume based Synchronized Intermittent Mandatory Ventilation) :
It controls Patient Ventilation to tidal volume from Synchronized Intermittent Mandatory Ventilation. ViTIDAL means inspiration volume to supply patient.

Warning

MEKANT synchronized spontaneous breathing or in case of without spontaneous breathing signal MEKANT ventilate by pressure.

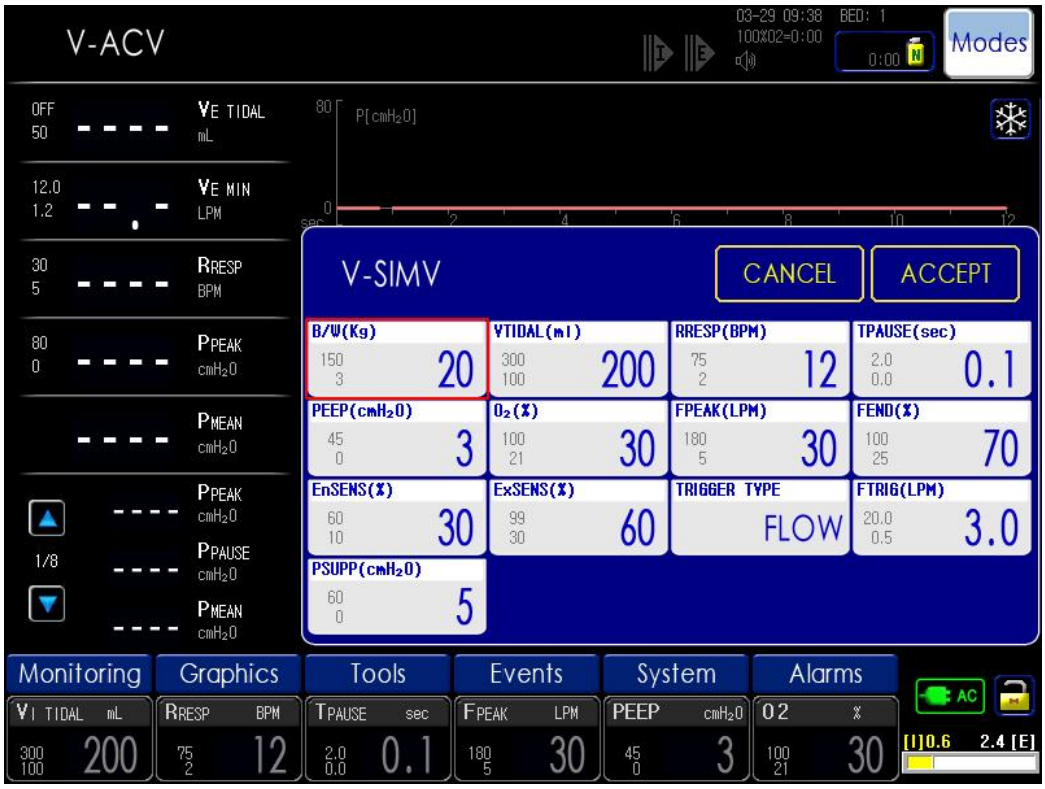


Figure ٣-٤-١-٢. V-SIMV SETTING screen

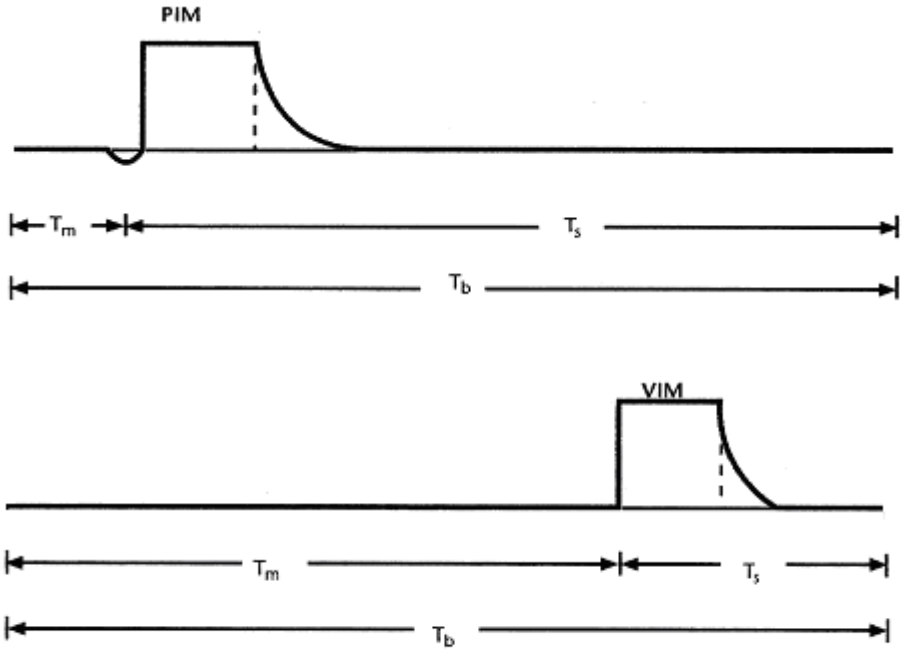
Item	Setting Range	Unit	Step	Explanation
V_{TIDAL}	۵ ~ ۲۵۰۰	mL	۵	It decides volume of ۱ breath. **NOTE :** It set the volume of patient weight. It is ۱۰mL per ۱kg. (You can set the volume per 1kg in [SYSTEM - SETUP - BWF] Menu.)
R_{RESP}	۲ ~ ۱۲۰	BPM	۱	It sets the respiratory rate per ۱ minute.
T_{PAUSE}	۰.۰ ~ ۲.۰	Sec	۰.۱	Inspiration Pause Time It set the inspiration time.
P_{EEP}	۰ ~ ۴۵	cmH_2O	۱	It set the PEEP pressure. (Base pressure of patient)
O_2	۲۱ ~ ۱۰۰	%	۱	It sets the percent of O_2 to patient.
F_{PEAK}	۵ ~ ۱۸۰	LPM	۱	It sets the flow-peak (maximum velocity) to patient.
F_{END}	۲۵ ~ ۱۰۰	%	۵	It sets percent of Flow (supply velocity) / Fpeak (supply maximum velocity) to End-tidal.
E_{nSENS}	۱۰ ~ ۶۰	%	۱۰	It sets the sensitivity of one breath completion of patient during to setting of percent of patient expiration volume.
E_{xSENS}	۱۰ ~ ۶۰	%	۱۰	It sets the sensitivity of one breath completion of patient during to setting of percent of patient inspiration volume.
TRIGGER TYPE	PRESSURE /FLOW	-	-	It sets the type of trigger. It is Pressure or Flow type.
$F(P)_{TRIG}$	۰.۵ ~ ۲۰	cmH_2O /LPM	۰.۵	Setting to detect spontaneous breathing signal, There are pressure and Flow type. User can select one.
P_{SUPP}	۰ ~ ۴۵	cmH_2O	۱	It sets the pressure to patient during spontaneous breathing.
ACCEPT	-	-	-	Execute V_{SIMV} Mode.
CANCEL	-	-	-	Go back to previous menu

Table ۳-۴-۱-۲. V-SIMV SETTING screen explanation

SIMV (Volume Control or Pressure Control) only Mandatory Breath

SIMV is a mixed ventilator mode that allows both mandatory and spontaneous breaths. SIMV mode differs to other company. SIMV of MEKANT guarantees one of mandatory breath per SIMV cycle. This mandatory breath works by patient initiated mandatory (PIM or Assisted Mandatory) breath or ventilator initiated mandatory (VIM or Controlled Mandatory).

As the below figure shows, each SIMV breath cycle (Tb) has two parts. One is the mandatory interval (Tm) and the other is Spontaneous Interval (Ts). PIM is delivered, the Tm interval ends and the ventilator switches to the spontaneous interval (Ts). If a PIM is not delivered, the ventilator delivers a VIM at the end of the mandatory interval, and then switches to the spontaneous interval.



In the SIMV mode of MEKANT, SIMV Breath Cycle is decided by respiratory rate of setting. If respiratory rate is ١٢ times, SIMV Breath Cycle is ٥ seconds. Mandatory Interval is defined as whichever is less ٠.٦ x SIMV Breath Cycle, or ١٠ seconds. Mandatory interval can be shorter according to PIM breath.

٣-٤-١-٣. P_{ACV}

P_{ACV}(Pressure based Assistance Controlled Ventilation) :

It controls Patient Ventilation by force from air pressure.

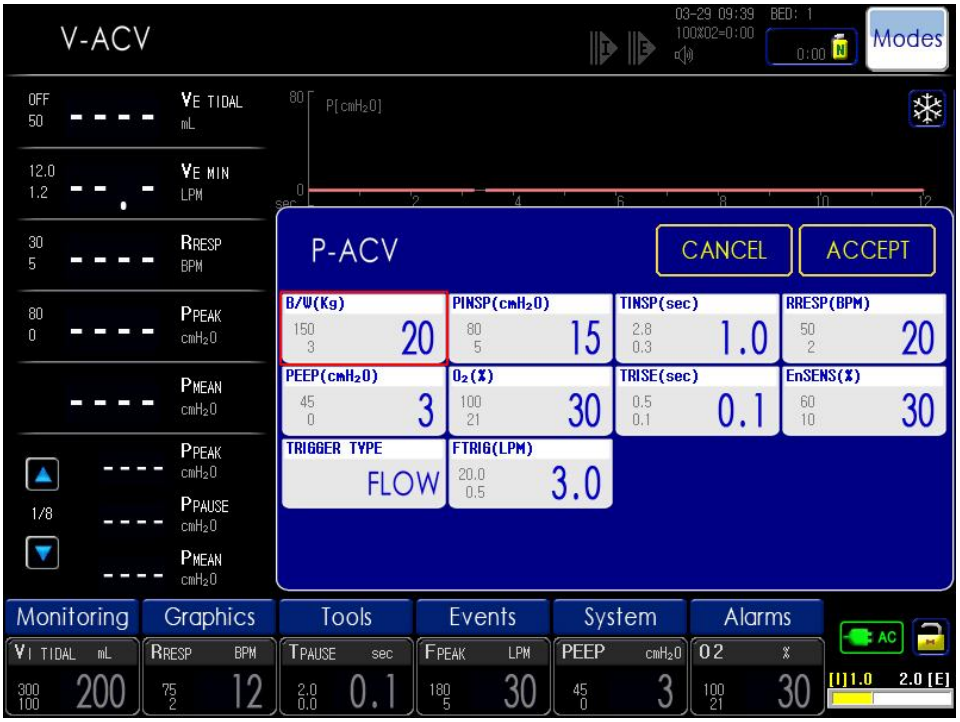


Figure 3-4-1-3. P-ACV SETTING screen

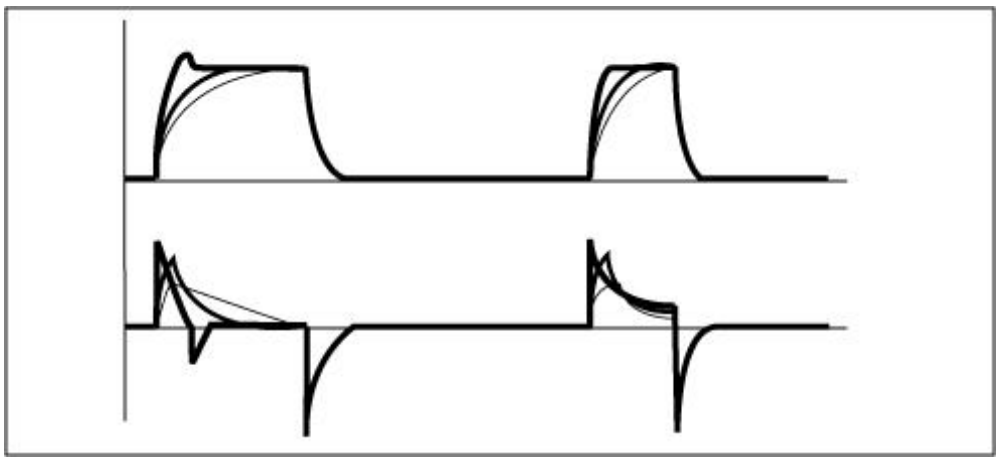
Item	Setting Range	Unit	Step	Explanation
P_{INSP}	٥ ~ ٨٠	cmH٢O	١	It sets the pressure to patient during inspiration.
T_{INSP}	٠.٢ ~ ٩.٩	sec	٠.١	It sets the inspiration time.
R_{RESP}	٢ ~ ١٢٠	BPM	١	It sets the respiratory rate per ١ minute.
P_{EEP}	٠ ~ ٤٥	cmH٢O	١	It sets the PEEP pressure. (Base pressure of patient)
O٢	٢١ ~ ١٠٠	%	١	It sets the percent of O٢ to patient.
TRISE	٠.١ ~ ٠.٥	sec	٠.١	It sets the flow speed of gas to patient.
E_{nSENS}	١٠ ~ ٩٠	%	١٠	It sets the sensitivity of one breath completion of patient during to setting of percent of patient expiration volume.
TRIGGER TYPE	PRESSURE /FLOW	-	-	It sets the type of trigger. It is Pressure or Flow type.
$F(P)_{TRIG}$	٠.٥ ~ ٢٠	cmH٢O /LPM	٠.٥	Setting to detect spontaneous breathing signal, There are pressure and Flow type. User can select one.
ACCEPT	-	-	-	Execute PACV Mode
CANCEL	-	-	-	Go back to previous menu

Table ٣-١٠. P_{ACV} Menu Explanation

A/C (Pressure Control) PACV

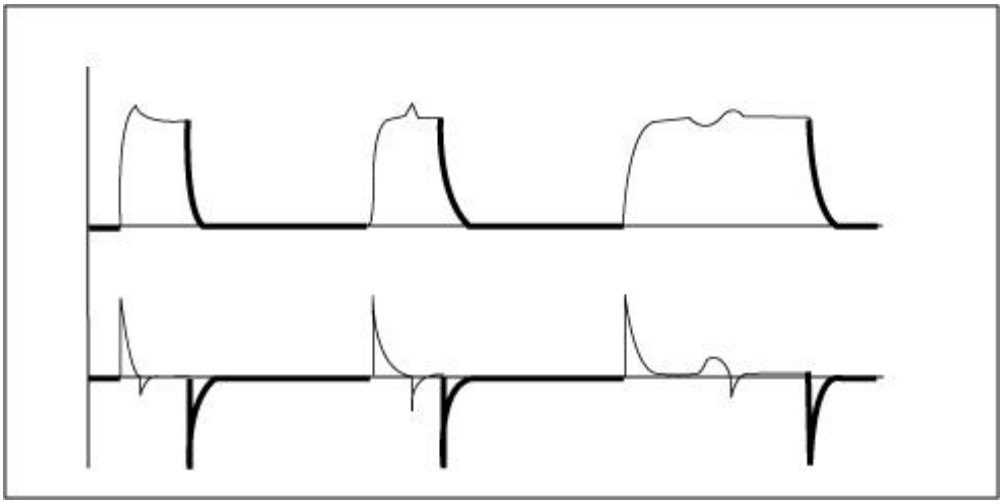
When MEKANT provide pressure control ventilation of mandatory breath, it draws inspiratory pressure instead of tidal volume and it sets I:E ratio or inspiratory tim e instead of peak flow same as other company.

But as the below figure shows, it is differ to slope of increase – baseline (PEEP) to Inspiratory pressure – according to setting of flow acceleration percent (FAP). According to an increment of FAP setting value, slope of pressure is rapid. If not slope of pressure is gentle. If you show slope of flow, you know that FAP is the change of flow volume to patient. FAP sets PCV and PSV each other.



MEKANT keeps on pressure regularly during inspiration same as other company. So it has Ramp shape of flow pattern and cannot use plateau function.

MEKANT is more activity and elaborateness for control of airway pressure becau se it has exhalation valve and active exhalation valve. So it controls pressure to exhalation valve in patient's talk, cough. And it allows spontaneous breath. It is s pecial function only MEKANT. It explain figure of next page.



٣-٤-١-٤. P_{SIMV}

P_{SIMV}(Pressure based Synchronized Intermittent Mandatory Ventilation) :
This mode is that MEKANT control artificial respiration by spontaneous breath and pressure.

Warning

MEKANT synchronized spontaneous breathing or in case of without spontaneous breathing signal MEKANT ventilate by pressure.

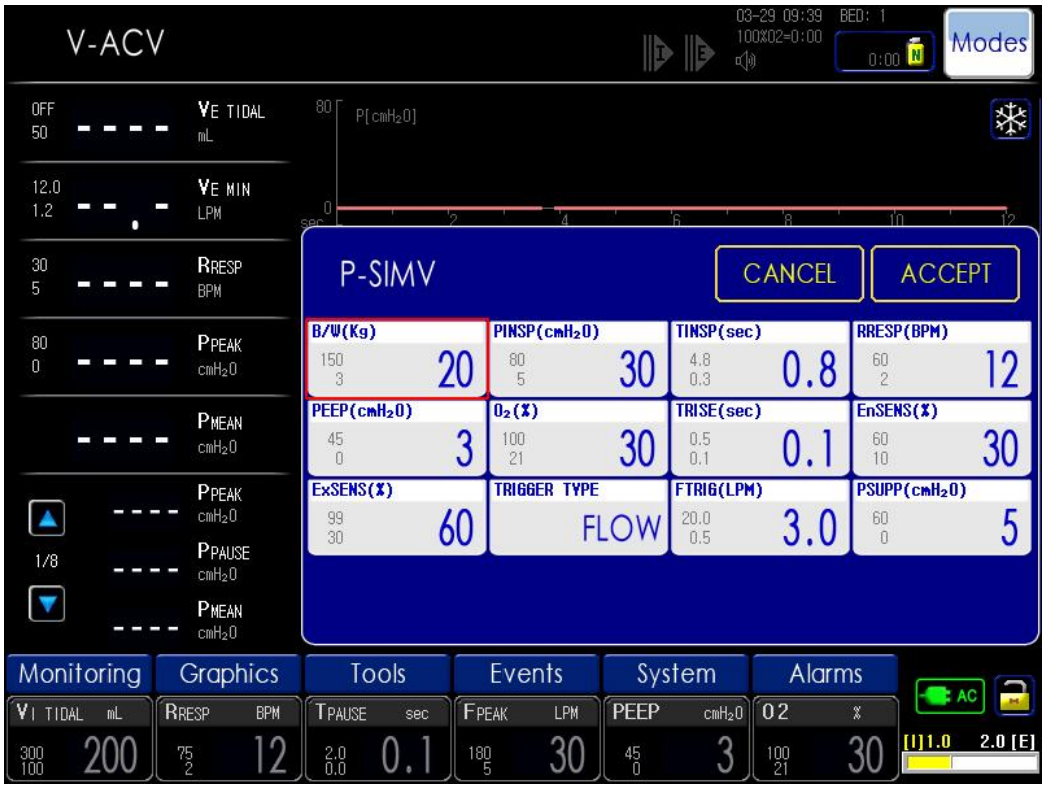


Figure ٣-٤-١-٤. P-SIMV SETTING screen

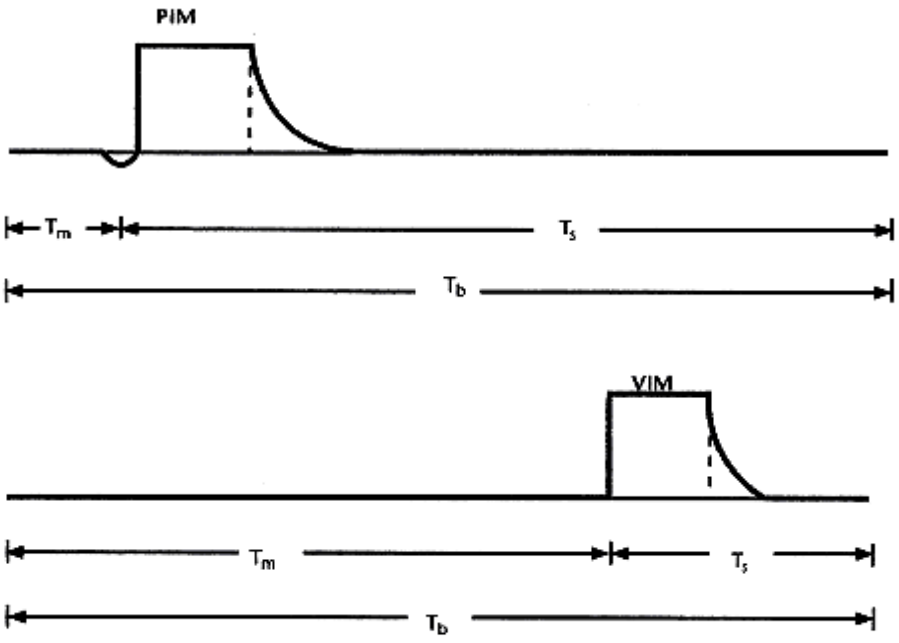
Item	Setting Range	Unit	Step	Explanation
P_{INSP}	۵ ~ ۸۰	cmH_2O	۱	Setting the patient pressure to once breath.
T_{INSP}	۰.۲ ~ ۹.۹	sec	۰.۱	Setting the inspiration Time.
R_{RESP}	۲ ~ ۱۲۰	BPM	۱	Setting number of breath per minute.
P_{EEP}	۰ ~ ۴۵	cmH_2O	۱	Setting PEEP pressure. (Base Pressure)
O_2	۲۱ ~ ۱۰۰	%	۱	Setting oxygen density.
TRISE	۰.۱ ~ ۰.۵	sec	۰.۱	It sets the flow speed of gas to patient
E_{nSENS}	۱۰ ~ ۶۰	%	۱۰	Setting sensitivity of expiration by ratio of expiration capacity.
E_{xSENS}	۱۰ ~ ۶۰	%	۱۰	Setting sensitivity of expiration by ratio of inspiration capacity.
TRIGGER type	PRESSURE /FLOW	cmH_2O /LPM	-	It set the type of trigger. It is Pressure or Flow type.
TRIGGER	۰.۵ ~ ۲۰	cmH_2O /LPM	۰.۵	Setting to detect spontaneous breathing signal, There are pressure and Flow type. User can select one.
PPS	۰ ~ ۴۵	cmH_2O	۱	Setting pressure of patient when it is working spontaneous breathing.
ACCEPT	-	-	-	Execute P-SIMV Mode.
CANCEL	-	-	-	Go back to previous menu

Table ۳-11. P_{SIMV} Menu Explanation

SIMV (Volume Control or Pressure Control) only Mandatory Breath

SIMV mode is able to work Mandatory Breath and Spontaneous Breath. MEKANT's SIMV mode is difference with other equipment. MEKANT's SIMV mode guarantees at least one Mandatory Breath per each cycle. This Mandatory Breath is one of the alternative Patient Initiated Mandatory (PIM or Assisted Mandatory) Breath or Ventilator Initiated Mandatory (VIM or Controlled Mandatory) Breath.

As bellow figure each SIMV Breath Cycle has two parts one is Mandatory Interval (Tm) and other one is Spontaneous Interval (Ts). After receive PIM Breath signal the Mandatory Interval was terminated and then to start Spontaneous Interval (Ts). If PIM Breath does not happen until Mandatory Interval terminate It will finish Mandatory Interval and then change to Spontaneous Interval with VIM Breath.



MEKANT SIMV mode's SIMV Breath Cycle depend on number of breath. For example if set Respiratory Rate is ١٢ SIMV Breath Cycle is ٥ sec. Mandatory Interval is taken smaller value maximum ١٠ sec or ٠.٦ x SIMV Breath Cycle. Mandatory Interval will be shorter by PIM Breath.

٣-٤-١-٥. SPONT

SPONT(Spontaneous Ventilation) :
It supports spontaneous breathing.

Warning

When MEKANT is working SPONT mode to apnea status during setting time, it change mode(V-ACV) of Apnea Backup setting automatically. It does change back SPONT mode, when 3 times spontaneous breaths within 10 seconds in apnea backup mode.

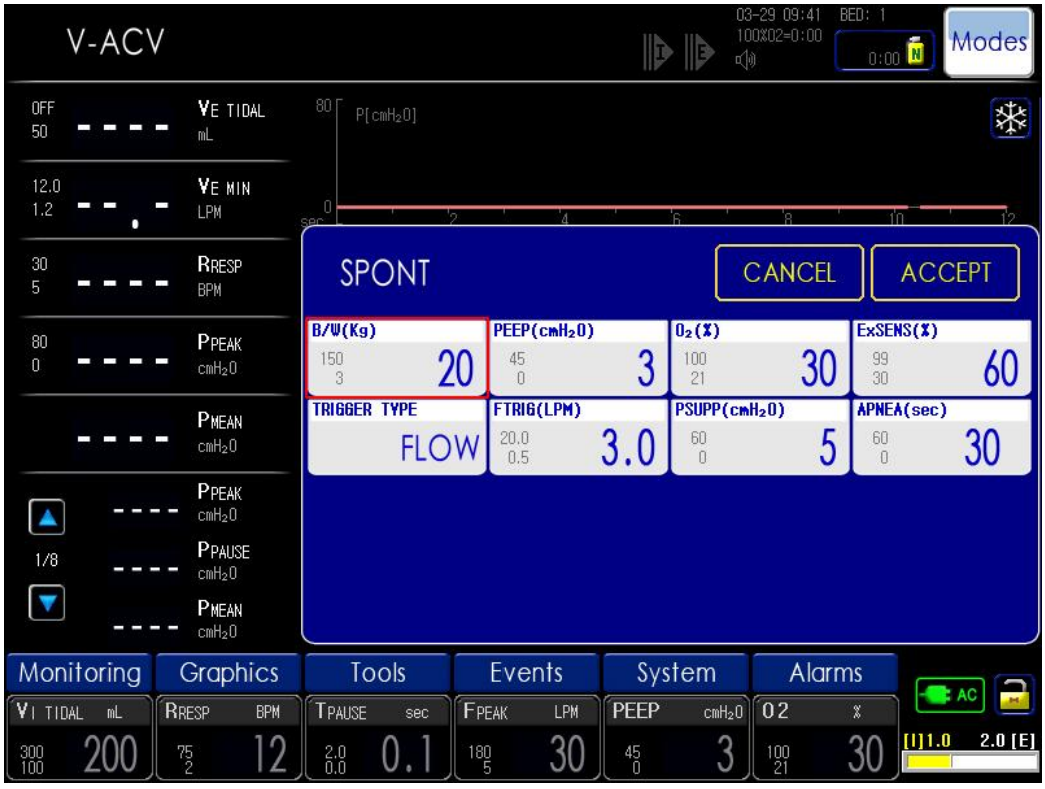


Figure ٣-٤-١-٥. SPONT SETTING screen

Item	Setting Range	Unit	STEP	Explanation
P_{EEP}	٠ ~ ۴۵	cmH_2O	١	It sets the PEEP pressure. (Base pressure of patient)
O_2	٢١ ~ ١٠٠	%	١	It sets the percent of O_2 to patient.
E_{xSENS}	١٠ ~ ۶٠	%	١٠	It sets the sensitivity of one breath completion of patient during to setting of percent of patient inspiration volume.
TRIGGER TYPE	PRESSURE /FLOW	-	-	It sets the type of trigger. It is Pressure or Flow type.
$F(P)_{TRIG}$	٠.۵ ~ ٢٠	cmH_2O /LPM	٠.۵	Setting to detect spontaneous breathing signal, There are pressure and Flow type. User can select one.
P_{SUPP}	٠ ~ ۴۵	cmH_2O	١	It sets the pressure to patient during spontaneous breathing.
APNEA	OFF ~ ۶٠	sec	١٠	If patient has not breath of setting time it works Apnea mode. It does not detect breath of patient during “OFF”
ACCEPT	-	-	-	Execute SPONT Mode.
CANCEL	-	-	-	Go back to previous menu

Table ٣-9. SPONT Menu Explanation

SPONT mode only

If spontaneous breath reaches to sensitivity, it makes pressure between setting of sensitivity and ١ cmH_2O through flow supply according to patient flow demand. If Pressure is bigger than ١ cmH_2O, it starts expiration to opening Exhalation valve. If patient has apnea breath, MEKANT occurs Apnea alarm and start Apnea ventilation (VACV Mode).

It works setting of Respiratory Rate, Tidal Volume, Inspiratory Pressure, Peak Flow, Inspiratory Time, FiO_2 and so on.

It works same as pressure support ventilation. Also if patient has apnea breath, MEKANT occurs Apnea alarm and start Apnea ventilation. But it change previous spontaneous mode if patient has ٣ times spontaneous breaths within ١٠ seconds.

٣-٤-١-٦. tBiLEVEL

tBiLEVEL: It works same as SPONT mode and it has Upper PEEP.

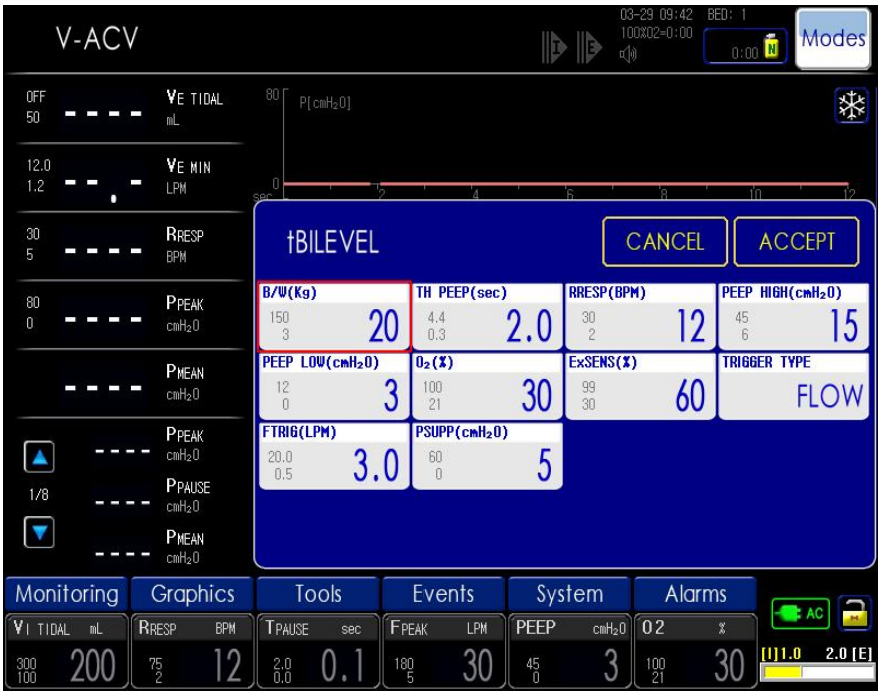


Figure ٣-٤-١-٦. tBiLEVEL SETTING screen

Item	Setting Range	Unit	STEP	Explanation
$T_{H\ PEEP}$	٠.٢ ~ ٢٤	sec	٠.١	Setting High PEEP Time. (Upper pressure holding time).
R_{RESP}	٢ ~ 30	BPM	١	Setting patient's number of breath.
$PEEP_{HIGH}$	٥ ~ ٤٥	cmH٢O	١	Setting High PEEP. (Upper pressure).
$PEEP_{LOW}$	٠ ~ ٤٥	cmH٢O	١	Setting Low PEEP. (Base Pressure of patient).
O٢	٢١ ~ ١٠٠	%	١	Setting oxygen density of air
E_{xSENS}	١٠ ~ ٦٠	%	١٠	Setting sensitivity of expiration by ratio of inspiration capacity.
TRIGGER TYPE	PRESSURE /FLOW	-	-	It sets the type of trigger. It is Pressure or Flow type.
$F(P)_{TRIG}$	٠.٥ ~ ٢٠	cmH٢O /LPM	٠.٥	Setting to detect spontaneous breathing signal, There are pressure and Flow type. User can select one.
P_{SUPP}	٠ ~ ٤٥	cmH٢O	١	Setting pressure of patient when it is working spontaneous breathing.
ACCEPT	-	-	-	Execute tBiLEVEL Mode.
CANCEL	-	-	-	Go back to previous menu

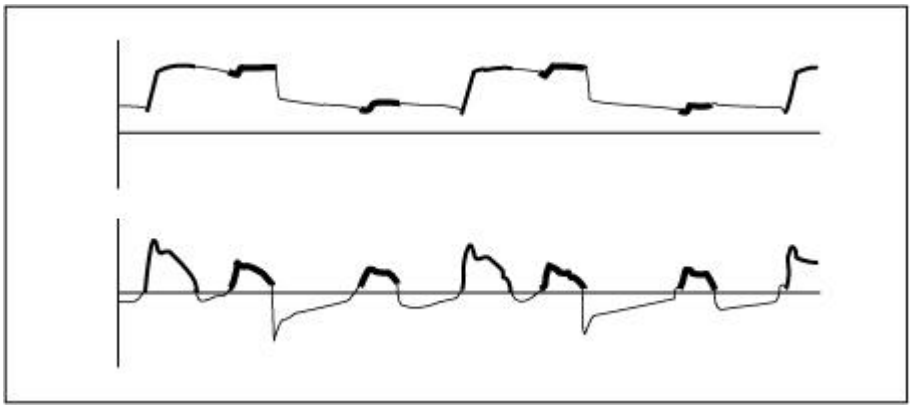
Table ٣-٤-١-٦. tBiLEVEL SETTING Explanation

tBILEVEL Mandatory Breath

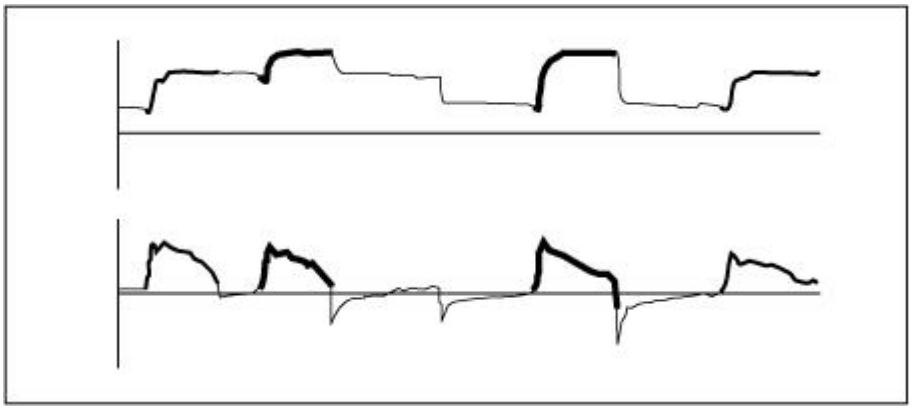
MEKANT's tBILEVEL mode is complex mode it may happened Mandatory Breath and Spontaneous Breath. Because it works as SIMV mode but it difference because Spontaneous range not fixed. So, anytime it is able to Spontaneous Breath.

tBILEVEL has two level of PEEP to supply patient. The upper PEEP is $PEEP_{HIGH}$ and lower PEEP is $PEEP_{LOW}$. Mandatory Breath's Inspiration is from $PEEP_{LOW}$ to $PEEP_{HIGH}$ and Expiration is from $PEEP_{HIGH}$ to $PEEP_{LOW}$. So tBILEVEL mode's Mandatory Breath is Pressure Control Ventilation. Each change time of before and after small zone is changing zone, this zone purpose is to detect patient breath if it detect patient breath it would adjust little early or late to start change inspiration and expiration for synchronizing with patient breathing.

Setting parameters are Respiratory Rate, $PEEP_{HIGH}$, $PEEP_{LOW}$ and so on, In case of Pressure Support Ventilation there is more add Support Pressure, FAP, Essens and so on.

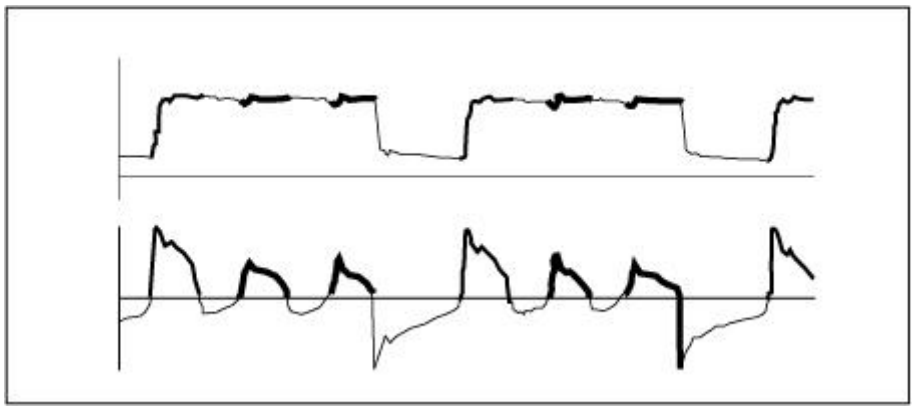


MEKANT's tBILEVEL mode supplies ١.٥ cmH_2O Pressure in Spontaneous Breath. If user want to more high pressure support it will use Pressure Support Ventilation setting. If Support Pressure + $PEEP_L$ value is higher than $PEEP_H$ It will be working pressure support ventilation difference than Spontaneous breath works Pressure Support Ventilation. Refer to the figure below.



tBILEVEL mode is able to work Spontaneous Breath any time it reduce fighting between ventilator and patient. It can reduce sedation so patient gets over more sort

All of Spontaneous Breath supplies Pressure Support Ventilation so patient feel more comfortable. If it using opposite I:E ratio it means very sort Expiratory Time it is Airway Pressure Release Ventilation(APRV) status. This APRV is one of best way to apply ARDS (Adult Respiratory Distress Syndrome).



٣-٤-١-٧. NIV

NIV : Mask type ventilation, it works similar P-ACV mode with air leakage.

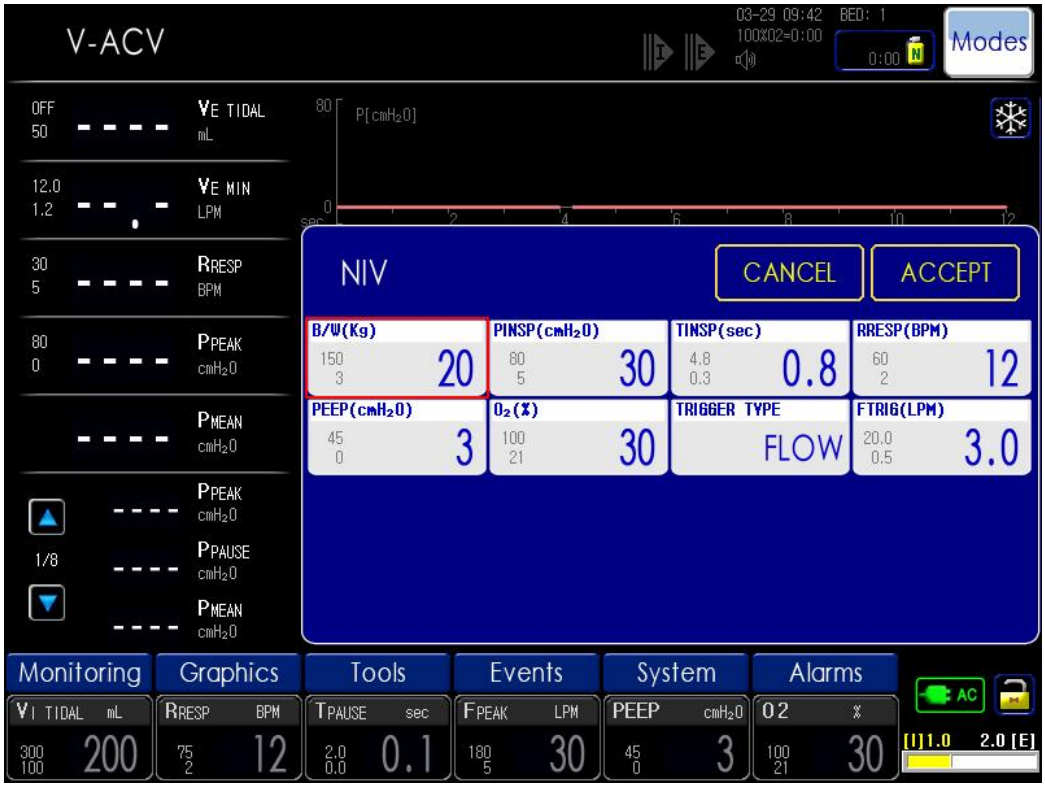


Figure ٣-٤-١-٧. NIV SETTING screen

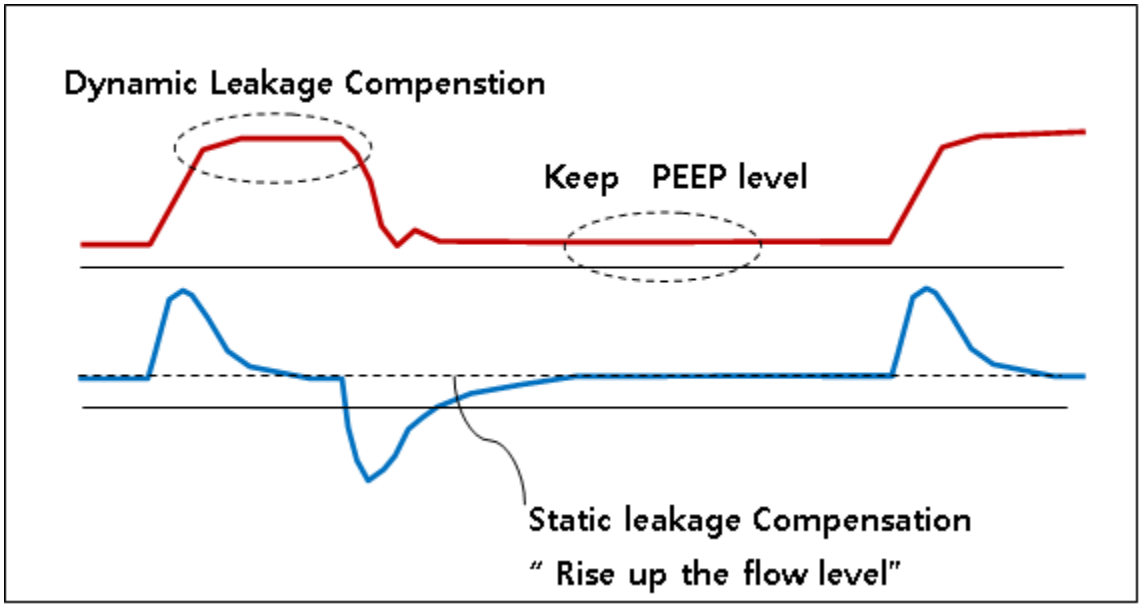
Item	Setting Range	Unit	STEP	Explanation
P_{INSP}	٥ ~ ٨٠	cmH٢O	١	Setting the patient pressure to once breath.
T_{INSP}	٠.٢ ~ ٩.٩	sec	٠.١	Setting the inspiration Time
R_{RESP}	٢ ~ ١٠٦	BPM	١	Setting number of breath per minute.
P_{EEP}	٠ ~ ٢٥	cmH٢O	١	Setting PEEP pressure. (Base Pressure)
O٢	٢١ ~ ١٠٠	%	١	Setting oxygen density.
TRIGGER TYPE	PRESSURE /FLOW	-	-	It set the type of trigger. It is Pressure or Flow type.
$F(P)_{TRIG}$	٠.٥ ~ ٢٠	cmH٢O /LPM	٠.٥	Setting to detect spontaneous breathing signal, There are pressure and Flow type. User can select one.
ACCEPT	-	-	-	Execute NIV Mode.
CANCEL	-	-	-	Go back to previous menu

Figure ٣-٤-١-٧. NIV SETTING screen explanation

▣ **NIV** (None Invasive Ventilation)

Mask type ventilation, it works similar P-ACV mode with air leakage. If air leak alarm occurs frequently, adjust inspiration and expiration leak volume.
It can set [Alarm] => [AIR LEAK] menu.

NIV mode need to prepare unexpected leak air, at the same time, must supply a stable pressure. During exhausted time, supply airway need to be feedback quickly.
By maintain flow trigger performance, it can be make stable PSV.



٣-٤-١-٨. PRVC

PRVC (Pressure Regulated Volume Controlled Ventilation) :
Breaths are delivered mandatorily to assure present volumes, with a constant inspiratory pressure continuously adapting to the patient's condition. The flow pattern is decelerating.

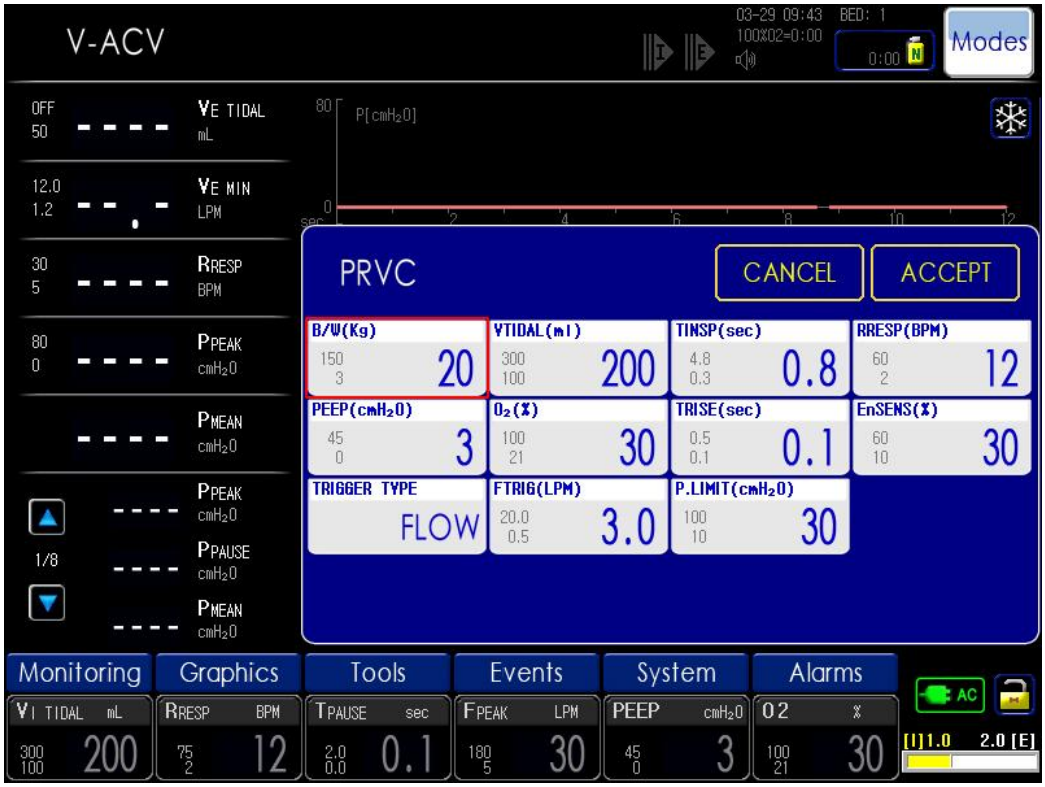


Figure ٣-٤-١-٨. PRVC SETTING screen

Item	Setting Range	Unit	STEP	Explanation
V_{TIDAL}	٥ ~ ٢٥٠٠	ml	٥	It decides volume of ١ breath. **NOTE :** It set the volume of patient weight. It is ١٠mL per ١kg. (You can set the volume per ١kg in [SYSTEM - SETUP - BWF] Menu.)
TINSP	٠.٢ ~ ٩.٩	sec	٠.١	Setting the inspiration Time
R_{RESP}	٢ ~ ١٢٠	BPM	١	It sets the respiratory rate per ١ minute.
P_{EEP}	٠ ~ ٤٥	cmH_2O	١	It sets the PEEP pressure.(Base pressure of patient)
O_2	٢١ ~ ١٠٠	%	١	It sets the percent of O_2 to patient.
TRISE	٠.١ ~ ٠.٥	sec	٠.١	It sets the flow speed of gas to patient
E_{nSENS}	١٠ ~ ٦٠	%	١٠	It sets the sensitivity of one breath completion of patient during to setting of percent of patient expiration volume.
TRIGGER TYPE	PRESSURE /FLOW	-	-	It sets the type of trigger. It is Pressure or Flow type.
$F(P)_{TRIG}$	٠.٥ ~ ٢٠	cmH_2O /LPM	٠.٥	Setting to detect spontaneous breathing signal, There are pressure and Flow type. User can select one.
$P_{RESSURE\ LIMIT}$	٣ ~ ٨٠	cmH_2O	٣٠	It sets the patient pressure limit to set over pressure.
ACCEPT	-	-	-	Execute PRVC Mode
CANCEL	-	-	-	Go back to previous menu

Table ٣-٤-١-٨. PRVC SETTING screen explanation

PRVC (Pressure Regulated Volume Controlled Ventilation)

Despite of the advantage of the pressure mode, a long time or a sudden change in status of the patient, or pure breathing changes for a long time, the PRVC mode resolve this instability mode.

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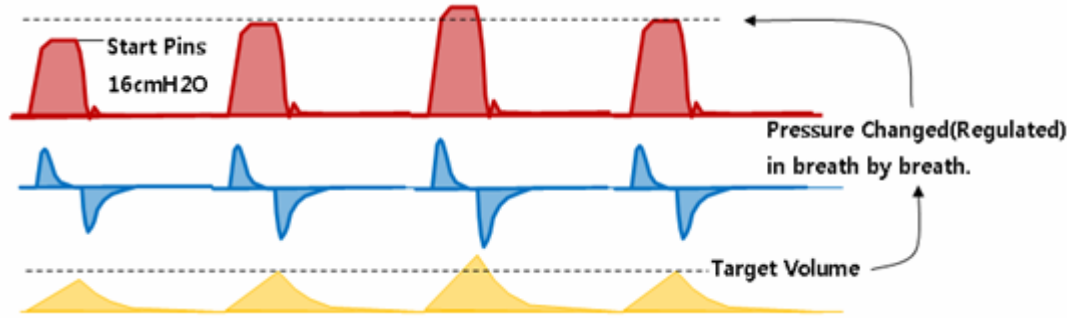
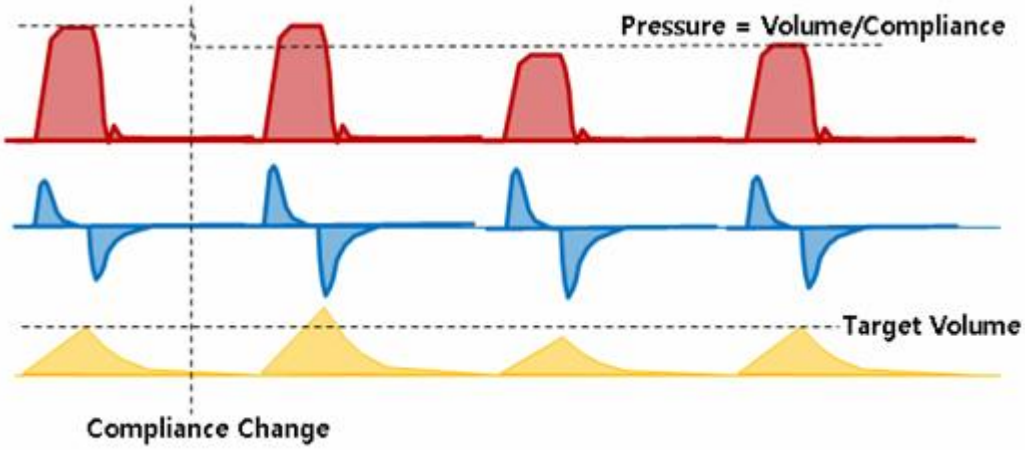


Initial Operation of PRVC (1st Breahing)



Pressure Regulation Operation at Compliance change of Patient

3-۴-۱-۹. AUTO

AUTO :

Emergency Quick Start function it requirement patient body weight. It works PACV Mode. This menu purpose is that in case of emergency patient user have to start quickly so it has minimum stability. All parameters are setup default and user can execute with only body weight. When "Auto Mode", on the top left corner, [AUTO] is flashing.

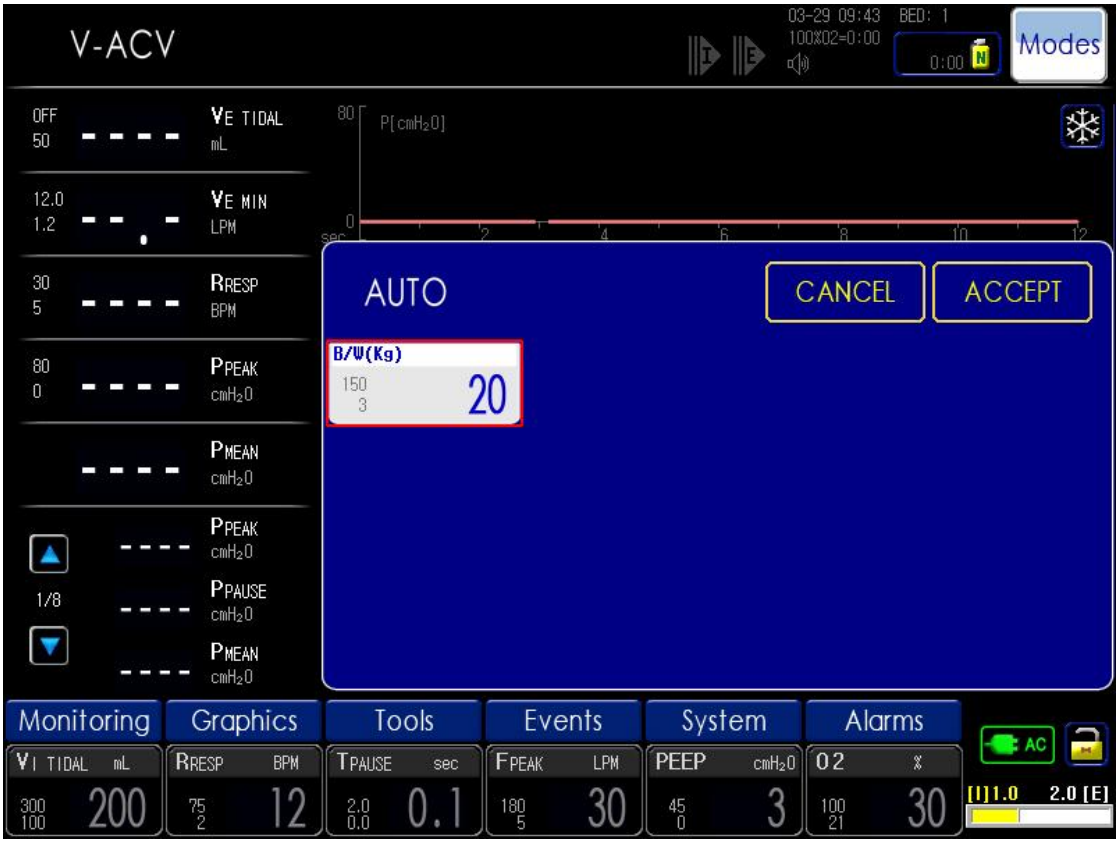


Figure ۳-۴-۱-۹. AUTO SETTING screen

Item	Setting Range	Unit	STEP	Explanation
ACCEPT	-	-	-	Execute AUTO Mode
CANCEL	-	-	-	Go back to previous menu

Table ۳-۴-۱-۹. AUTO SETTING screen explanation

٣-٤-٢. Monitoring

Overall, the measured data shows for each mode.

Table 1 : Display the contents about ventilator.

Table ٢: Display HR, $SpO_٢$, $EtCO_٢$, Ins, R_{RESP}.

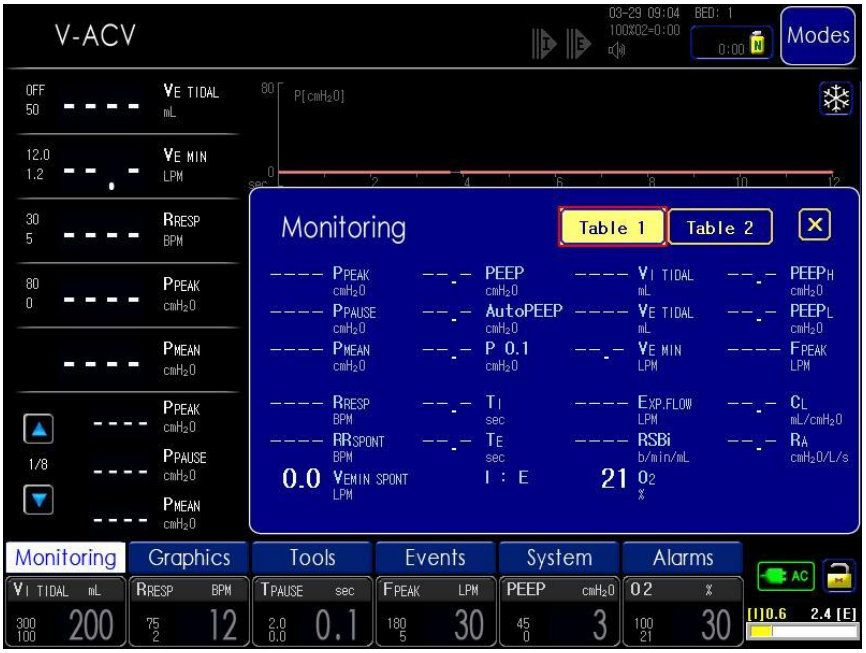


Figure 3-4-2-(1). Monitoring screen(Table 1)

Figure 3-4-2-(2). Monitoring screen(Table 2)

٣-٤-٣. Graphics

By using Graphics menu, you can change each Screen Layout and Trend Timing. Refer to [Figure 3-4-3(1)].

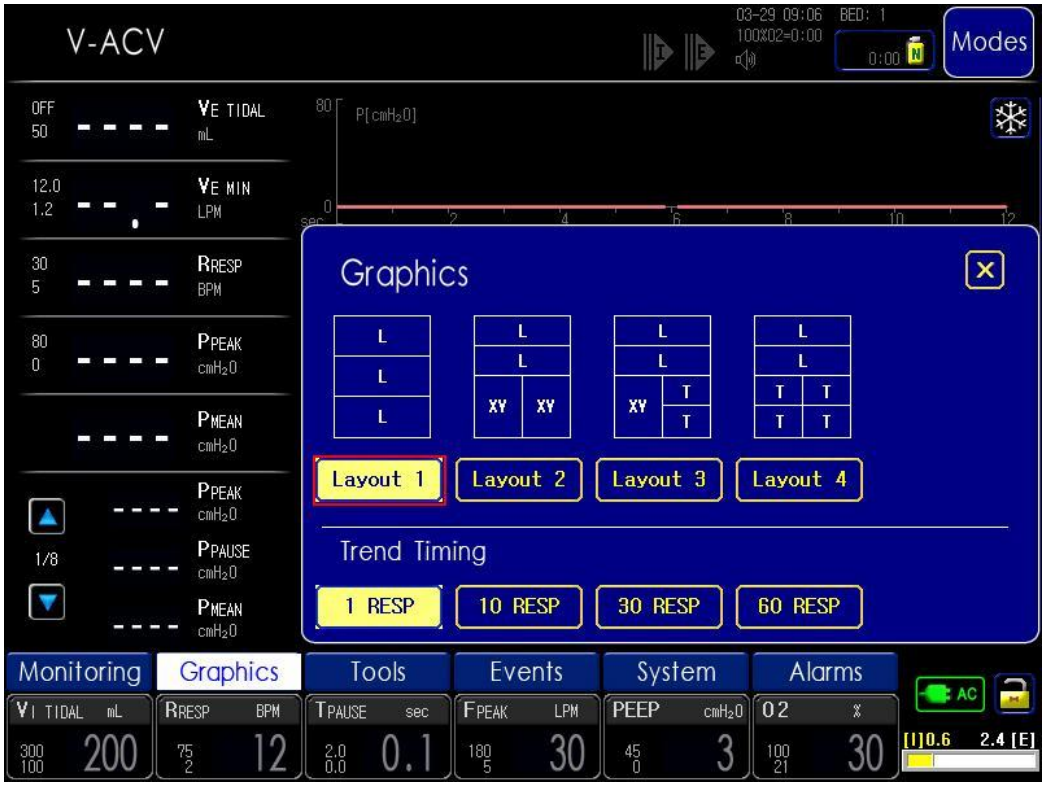
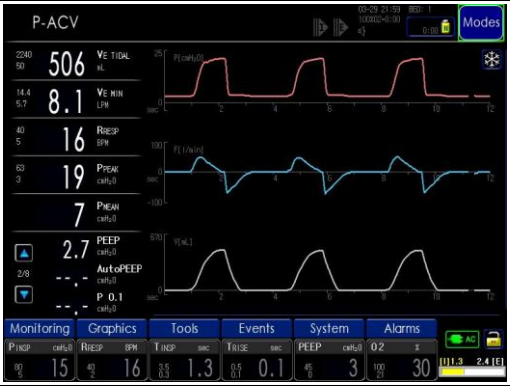
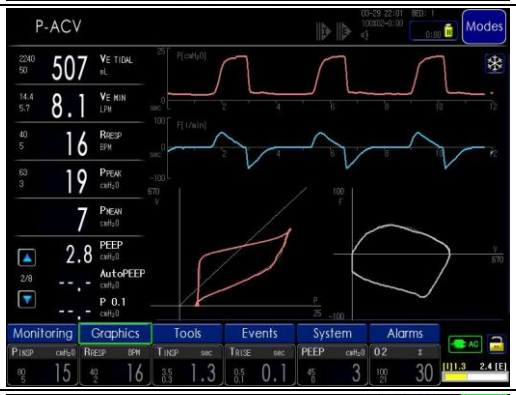
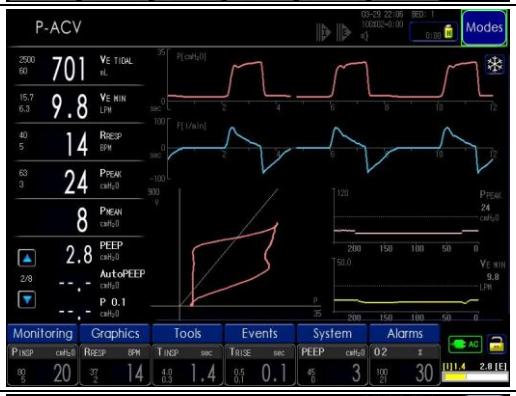


Figure ٣-٤-٣(1). Graphics screen

You can change the update period of Trend screen.

When set to [١ RESP], Trend data will be updated each respiratory.

When Layout select, the screen arrangement will be change as follow.

Item	Explanation
	**Layout** ١ Pressure, Flow, Volume graphs are displayed.
	**Layout** ٢ Two graphs among Pressure, Flow, Volume are displayed. Two graphs among P-V, V-F, P-F are displayed.
	**Layout** ٣ Two graphs among Pressure, Flow, Volume are displayed. One graph among P-V, V-F, P-F are displayed. Two trend graphs are displayed.
	**Layout** ٤ Two graphs among Pressure, Flow, Volume are displayed. Four trend graphs are displayed.

The method of selecting a graph, just touch the screen.

The TOUCH areas are [Figure 3-4-3(2)] as follow;

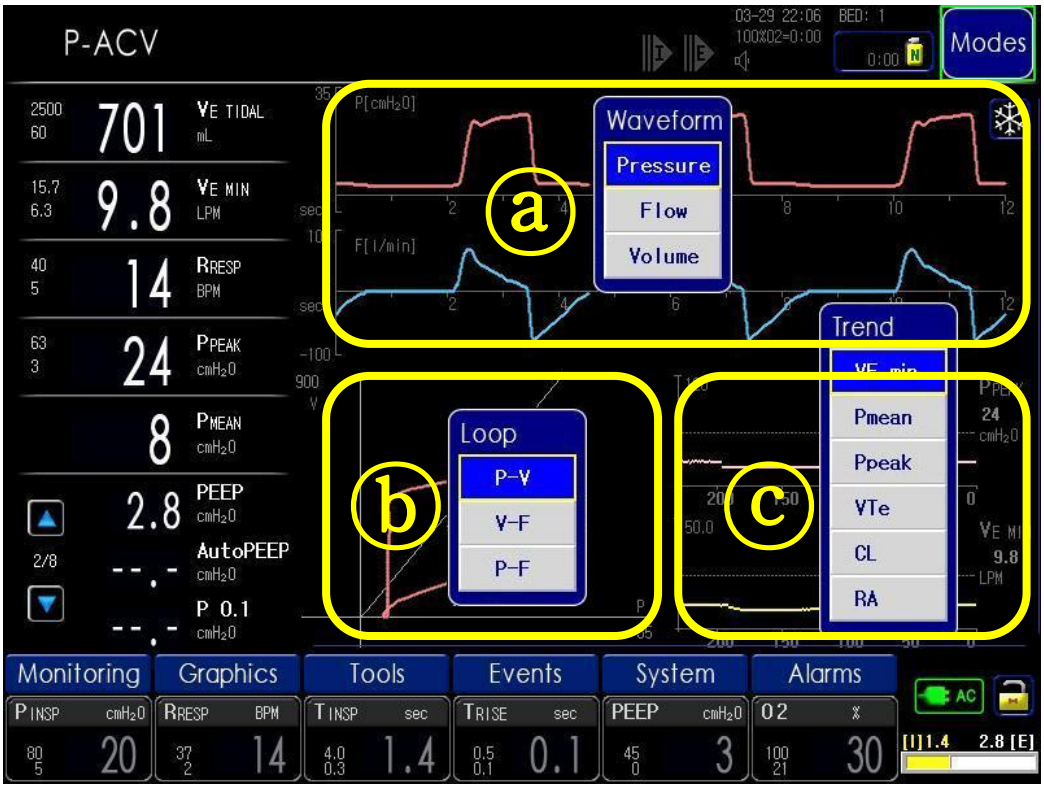


Figure ٣-٤-٣(٢). Graphics TOUCH areas

Item	Explanation
ⓐ	Waveform graph display. When waveform TOUCH, select menu is displayed.
ⓑ	Loop graph display. When Loop graph TOUCH, select menu is displayed.
ⓒ	Trend graph display. When Trend graph TOUCH, select menu is displayed.

Table ٣-٤. Graphics menu explanation

٣-٤-٤. Tools

This menu is to measure [Inspiration hold time] and [Expiration hold time].

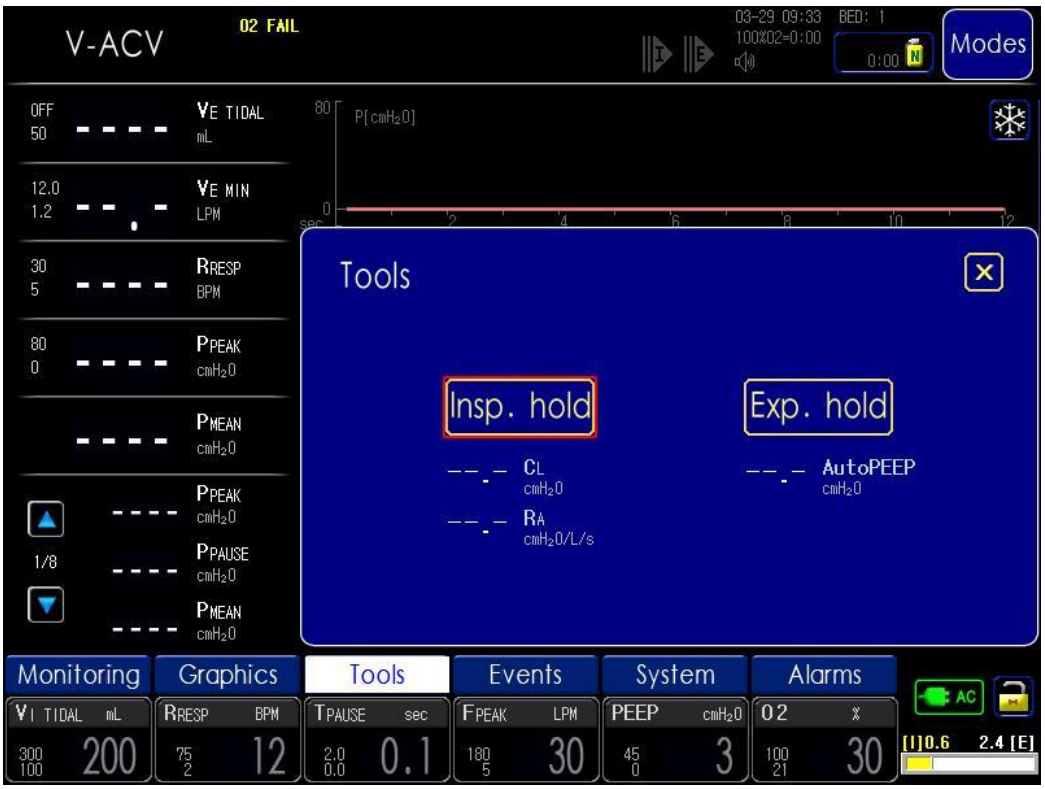


Figure ٣-٤-٤. Tools screen

Item	Explanation
Insp. hold	It measures for ١ second the compliance and resistance.
Exp. hold	After EXPIRATION ١ second holding, it measures the AUTO PEEP.

Table ٣-٤-٤. Tools Explanation

٣-٤-٥. Events

When an event occurs, Events screen can be found at.

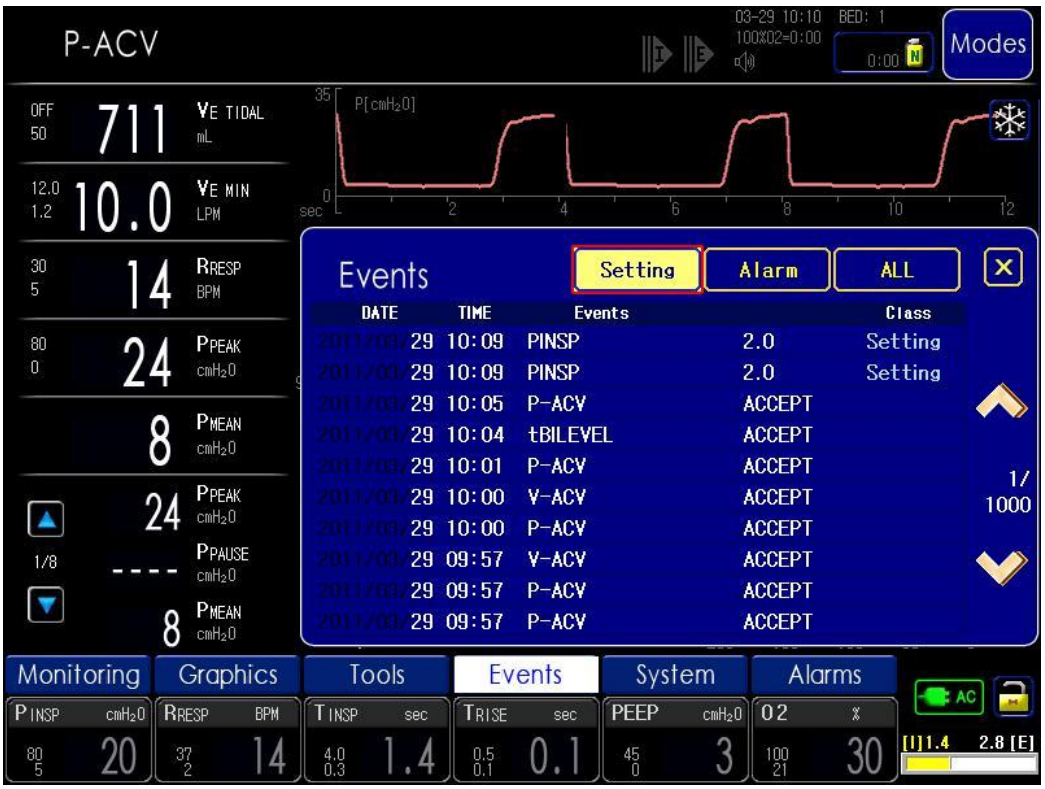


Figure ٣-٤-٥. Events screen

Item	Explanation
Setting	When alarm setting change, events will be displayed.
Alarm	When alarms appear, events will be displayed.
ALL	All events will be displayed.

Table ٣-٤-٥. Events explanation

٣-٤-٦. SYSTEM

SYSTEM MENU is made up SETUP menu, PATIENT menu, DATE menu and CALIBRATION menu.

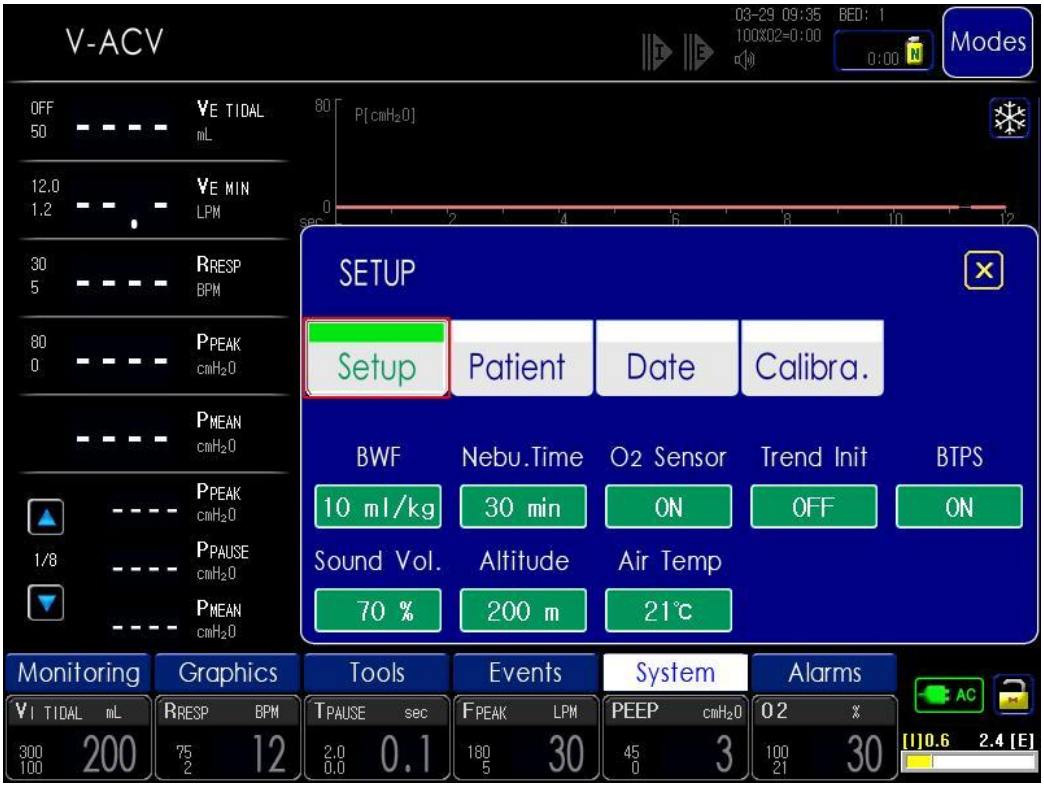


Figure ٣-٤-٦. SETUP MENU screen configuration

٣-٤-٦-١. SETUP

It is setting for user. There are BWF, Nebulizer time, O٢ sensor ON/OFF, Initial Trend, BTPS ON/OFF, Sound Volume, Altitude, Air temperature.

Item	Explanation	Ref.
BWF	Setting body weight of patient in mL/kg.	٣-٤-٥-٤-١
Nebu. Time	Setting operating time of nebulizer(١٠ ~ ١٨٠ minutes)	٣-٤-٥-٤-٢
O٢ Sensor	Set to use the O٢ Sensor.	٣-٤-٥-٤-٣
Trend Init	Initialize Trend graph and Trend data.	٣-٤-٥-٤-٤
BTPS	BTPS ON/OFF switch.	٣-٤-٥-٤-٥
Sound Vol.	Adjust sound volume.	٣-٤-٥-٤-٦
Altitude	Set the altitude.	٣-٤-٥-٤-٧
Air Temp	Set the air temperature.	٣-٤-٥-٤-٨

Table ٣-٤-٦-١. SETUP MENU screen explanation

٣-٤-٦-١-١. BWF

Set body weight of patient in mL/kg.

Item	Setting Range	Unit	STEP	Explanation
BWF	٥~١٥	mL/kg	١	Volume / Body weight

Table ٣-٤-٦-١-١. B/W FACTOR explanation

٣-٤-٦-١-٢. Nebu. Time

Set nebulizer operating time in minute.

Item	Setting Range	Unit	STEP	Explanation
Nebulizer Time	١٠ ~ ١٨٠	min	١٠	Setting operating time of nebulizer.

Table ٣-٤-٦-١-٢. Nebu. Time explanation

٣-٤-٦-١-٣. O٢ SENSOR

Set to use the O٢ Sensor ON/OFF.
- ON : It is setting O٢ sensor is normal.
- OFF : Set O٢ sensor is abnormal or O٢ Gas is empty.

Item	Setting Range	Unit	STEP	Explanation
O٢ SENSOR	ON / OFF	-	-	Set to use the O٢ Sensor ON/OFF.

Table ٣-٤-٦-١-٣. O٢ SENSOR explanation

٣-٤-٦-١-٤. Trend Init.

Initialize Trend graph and Trend data.

٣-٤-٦-١-٥. BTPS

BTPS is "**B**ody **T**emperature and **P**ressure **S**aturated with Water Vapor".

In respiratory physiology lung volumes and flows are standardized to barometric pressure at sea level.

Item	Setting Range	Unit	STEP	Explanation
BTPS	ON / OFF	-	-	BTPS ON/OFF switch.

Table ٣-٤-٦-١-٥. BTPS explanation

٣-٤-٦-١-٦. Sound Vol.

Adjust sound and beep volume.

Item	Setting Range	Unit	STEP	Explanation
Sound Vol.	١٠ ~ ١٠٠	%	١٠	Set alarm sound volume.

Table ٣-٤-٦-١-٦. Sound Vol. explanation

٣-٤-٦-١-٧. Altitude

Set altitude height in meter.

Item	Setting Range	Unit	STEP	Explanation
ALTITUDE	-١٠٠ ~ ٥٠٠٠	METER	٢٠	Set height of altitude.

Table ٣-٤-٦-١-٧. Altitude explanation

٣-٤-٦-١-٨. Air Temp.

Set air temperature in centigrade.

Item	Setting Range	Unit	STEP	Explanation
Air Temp	٠ ~ ٥٠	℃	١	Set air temperature of centigrade.

Table ٣-٤-٦-١-٨. Air Temperature explanation

٣-٤-٦-٢. PATIENT

Input the patient's information.

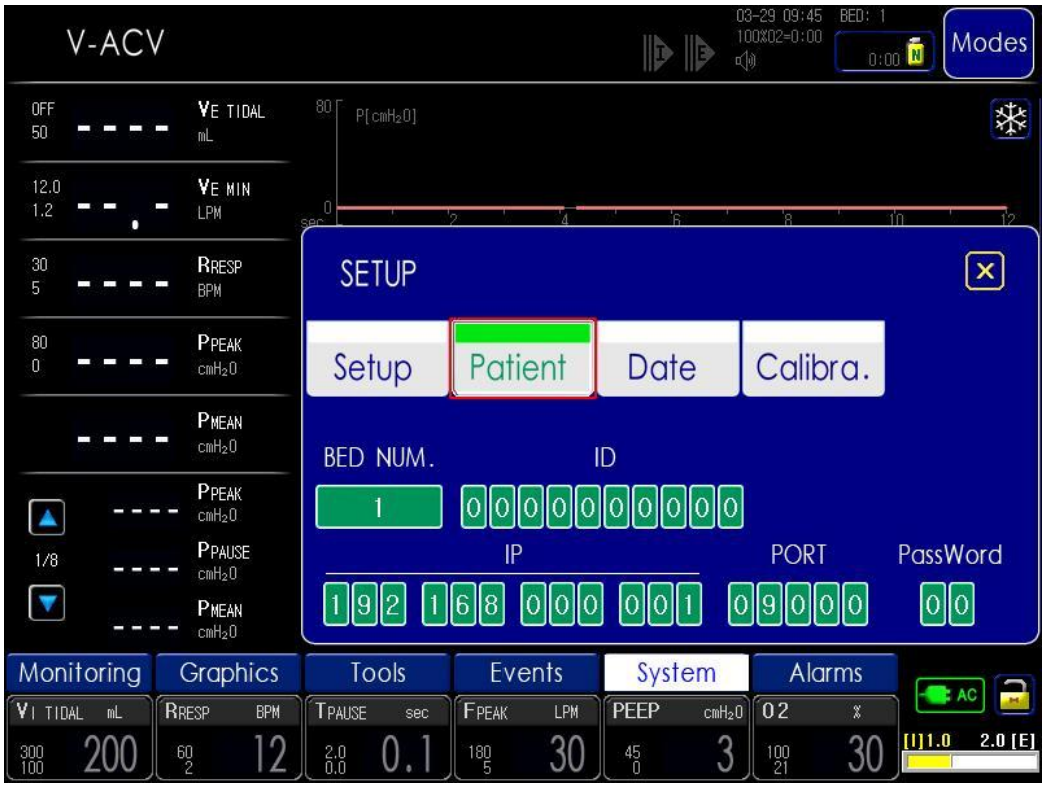


Figure ٣-٤-٦-٢. PATIENT screen

Item	Mode	Explanation
BED NUM.	-	Set BED Number
ID	-	Set the patient's ID number.
IP	-	External communication with a LAN connection, Set the IP address number.
PORT	-	External communication with a LAN connection, Set the IP PORT number.
PassWord	-	Enter the password(77) for IP and PORT.

Table ٣-٤-٦-٢. Patient screen explanation

٣-٤-٦-٣. Date

Set date and time.

There are main and pneumatic SW version information, Ventilator operating time.

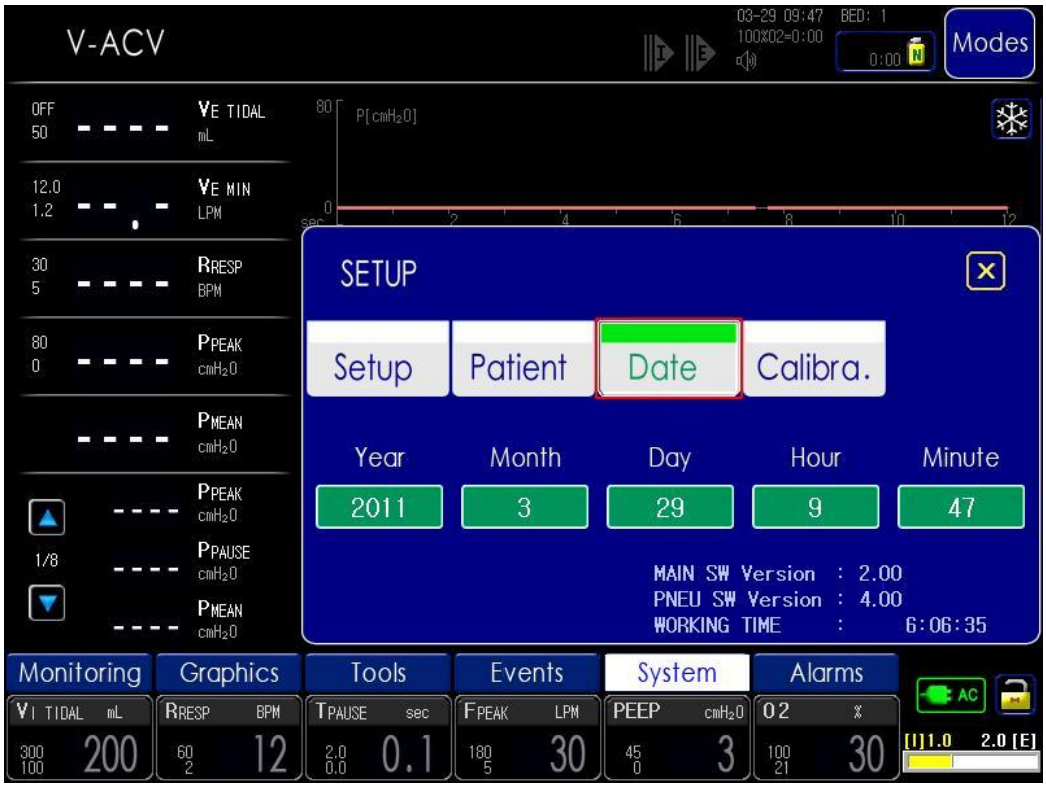


Figure ٣-٤-٦-٣. Date screen

۳-۴-۶-۴. Calibration

You can perform the Calibration of Ventilator, O_2 sensor, Ins-Exp, $EtCO_2$.

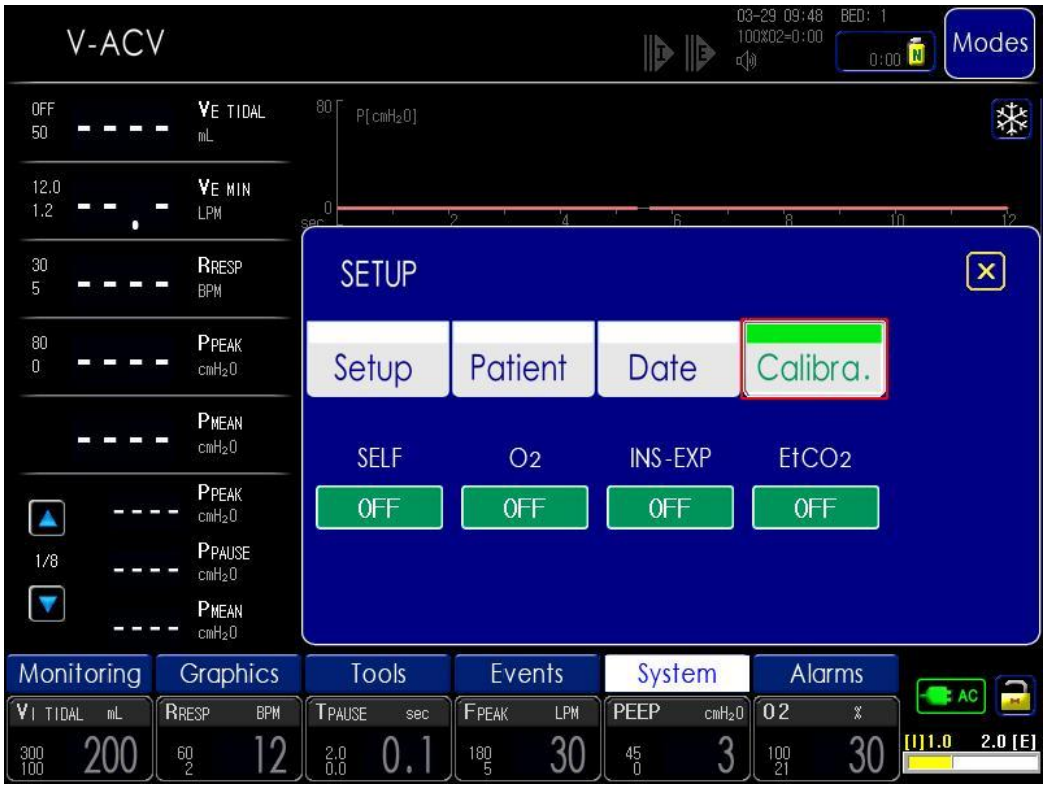


Figure ۳-۴-۶-۴. Calibration screen

Item	Explanation	Ref.
SELF	It is calibration mode for flow sensors.	۳-۴-۶-۴-۱
O_2	Calibration O_2 Sensor	۳-۴-۶-۴-۲
INS-EXP	It is calibration mode for striking balance between inspiration flow sensor and expiration flow sensor.	۳-۴-۶-۴-۳
$EtCO_2$	Calibration $EtCO_2$ Sensor	۳-۴-۶-۴-۴

Table ۳-۴-۶-۴. Calibration explanation

٣-٤-٦-٤-١. SELF CALIBRATION

It is calibration mode for flow sensors. It has ٢ flow sensor calibrations. One is offset calibration of Inspiration flow sensor and the other is offset calibration of expiration flow sensor.

CAUTION : Before calibration, MV ٣٥٠٠ must be separated from patient.

Item	Range	Explanation
SELF CALIBRATION	START / OFF	Inspiration and expiration flow sensor offset calibration.

Table ٣-٤-٦-٤-١. SELF CALIBRATION explanation

٣-٤-٦-٤-٢. O_2 CALIBRATION

Calibrate O_2 Sensor. Push the encoder button and O_2 calibration start. After few seconds O_2 calibration is stopped. Measured O_2 sensor calibration data is saved in memory.

Item	Range	Explanation
O_2 CALIBRATION	START / OFF	Calibration O_2 Sensor

Table ٣-٤-٦-٤-2. O_2 CALIBRATION explanation

٣-٤-٦-٤-٣. INS-EXP CALIBRATION

It is calibration mode for striking balance between inspiration flow sensor and expiration flow sensor.

Item	Range	Explanation
INS-EXP CALIBRATION	START / OFF	It is calibration mode for striking balance between inspiration flow sensor and expiration flow sensor. Turn the encoders to the left and right, Ins Volume and Exp Volume is adjusted to match.

Table ٣-٤-٦-٤-٣. INS-EXP CALIBRATION explanation

Turn the encoders to the left and right, you should be adjusted to match the measured data and setting data.

For more accurate INS-EXP CALIBRATION, operated the ventilator for ٣ hours and then INS-EXP CALIBRATION can get better results.

The important things to note that [EXP. GAS] setting is set to DRY GAS state, and then start INS-EXP CALIBRATION. If [EXP. GAS] be set HUMID GAS, less volume is measured.

BF means Base Flow. BF is the difference of inspiratory flow and expiratory flow.

۳-۴-۶-۴-۴. EtCO۲ CALIBRATION

If you have $EtCO_2$ module, Calibration is performed.

Item	Range	Explanation
EtCO۲ CALIBRATION	START / OFF	CALIBRATION EtCO۲

Table ۳-۴-۶-۴-4. $EtCO_2$ CALIBRATION explanation

٣-٤-٧. ALARM SET

To adjust alarm levels for each measured value, Turn the encoders to the left and right, and then set the value.

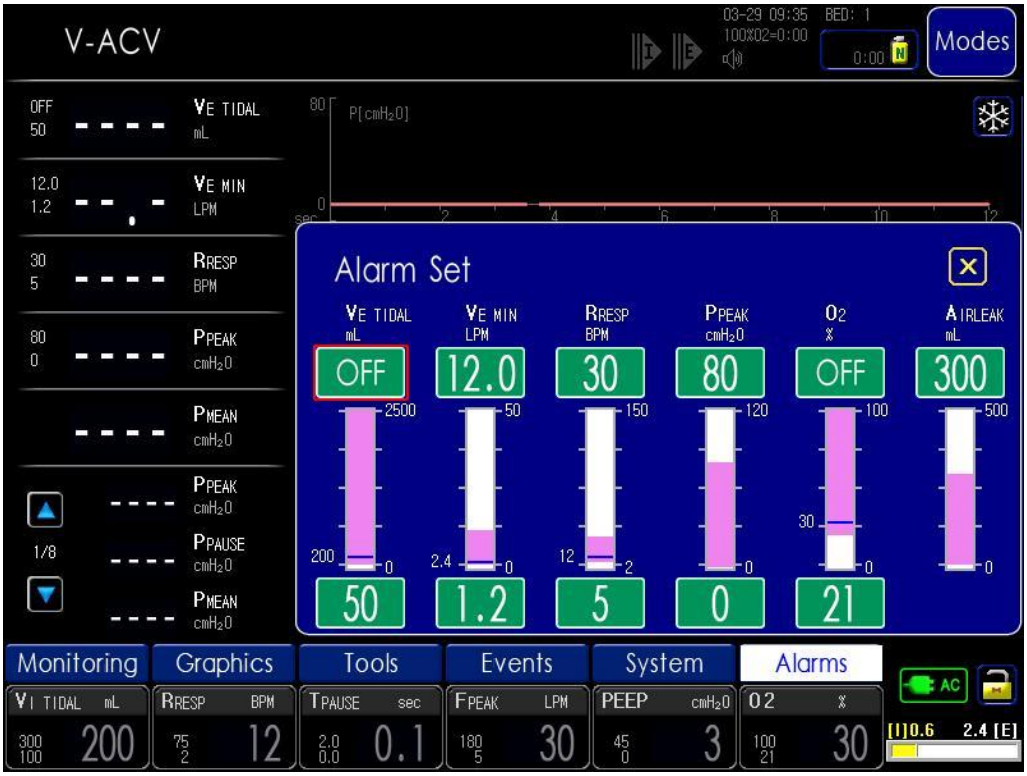


Figure ٣-٤-٧. Alarm setting screen

Item	Setting Range	Unit	STEP	Explanation
$V_{E\ TIDAL\ HIGH}$	٢٠ ~ ٢٥٠٠,OFF	mL	١٠	Upper limit of patient's capacity.
$V_{E\ TIDAL\ LOW}$	OFF, ٠ ~ ٢٥٠٠	mL	١٠	Lower limit of patient's capacity.
$V_{E\ MIN\ HIGH}$	٠.1 ~ 50.0	LPM	٠.١	Upper limit of patient's breath of capacity.
$V_{E\ MIN\ LOW}$	٠.٠ ~ 49.9	LPM	٠.١	Lower limit of patient's breath of capacity.
$R_{RESP\ HIGH}$	٢~ ١٥٠	BPM	١	Upper limit of number of breath per minute.
$R_{RESP\ LOW}$	٢~ ١٥٠	BPM	١	Lower limit of number of breath per minute.
$P_{PEAK\ HIGH}$	٠ ~ ١٢٠, OFF	cmH_2O	١	Upper limit of patient's pressure.
$P_{PEAK\ LOW}$	OFF, ٠ ~ ١٢٠	cmH_2O	١	Lower limit of patient's pressure.
$O_{2\ HIGH}$	٠ ~ ١٠٠, OFF	%	١	Upper limit of oxygen's density.
$O_{2\ LOW}$	OFF, ٠ ~ ١٠٠	%	١	Lower limit of oxygen's density.
AIR LEAK	٠ ~ ٥٠٠	mL	١٠	Difference breath of capacity between Ins. Volume and Exp. Volume.

Table ٣-٤-٧. ALARM screen explanation

Section ۴ : Alarms ۸۷

۴-۱. General Information ۸۷

۴-۲. Alarm Massage ۸۸

Section ۴ : Alarms

۴-۱. General Information

All alarm indicates condition of each situation on LED display window. LCD monitor shows their warning message.

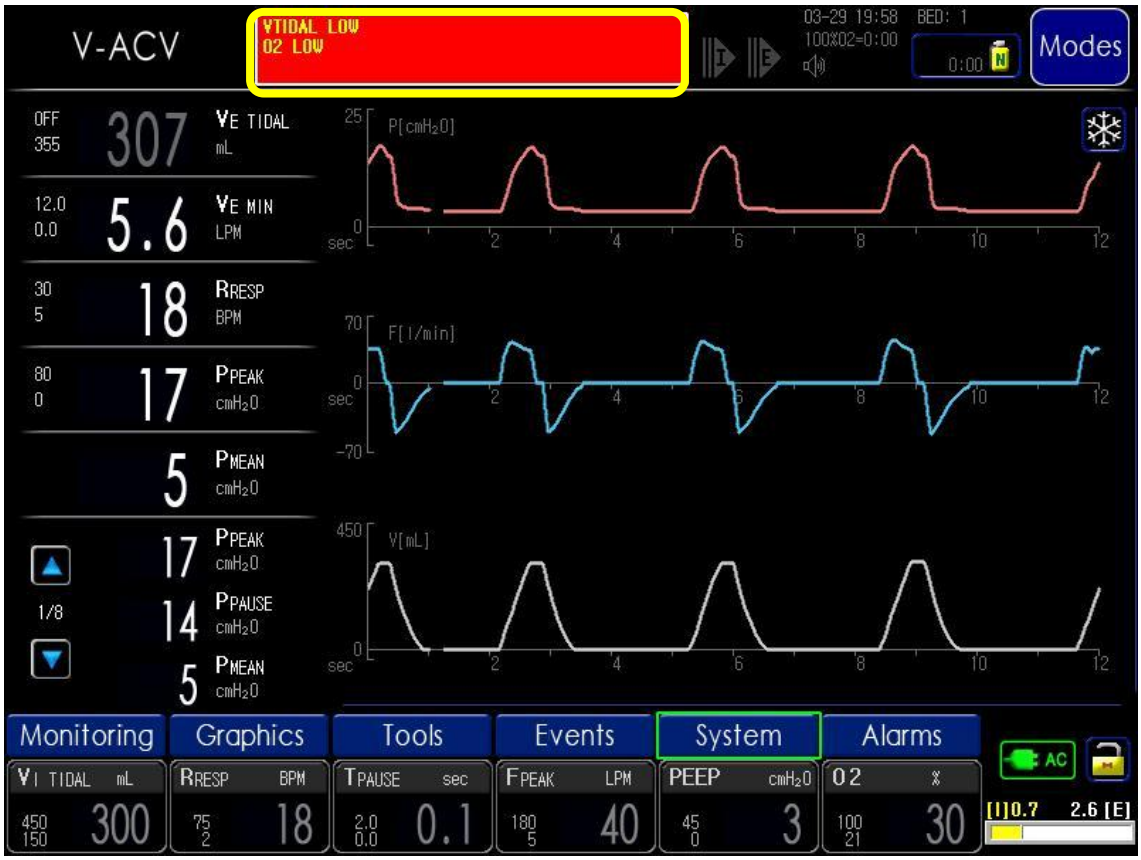


Figure ۴-۱. Alarm screen

۴-۲. Alarm Message

If alarm message is indicated, check the current mode and solve the problem according to it.

Item	Alarm range
PRESSURE HIGH	۵ cmH_2O ~ ۱۲۰ cmH_2O
PRESSURE LOW	۰ cmH_2O ~ ۵۰ cmH_2O
VTIDAL HIGH	۵ ml ~ ۲۵۰۰ ml ,OFF
VTIDAL LOW	۰ ml ~ ۲۵۰۰ ml
PEEP HIGH	۶ cmH_2O ~ ۴۵ cmH_2O
PEEP LOW	۰ cmH_2O ~ ۷ cmH_2O
O_2 HIGH	۱% ~ ۱۰۰%, OFF
O_2 LOW	۰% ~ ۱۰۰%
R-R HIGH	۳ ~ ۱۵۰ BPM
R-R LOW	۲ ~ ۱۴۹ BPM
VMIN HIGH	۰.۱ ~ ۵۰ LPM
VMIN LOW	۰ ~ ۴۹.۹ LPM
AIR FAIL	-
O_2 FAIL	-
AIR LEAK	۰ ml ~ ۵۰۰ ml
AIR OBST	-
APNEA	OFF, ۱۰ ~ ۶۰ sec
VENT INOP	-
O^2 SENSOR ERR	-
CIRCUIT OPEN	-
BATTERY MODE	-
LOW BATTERY	DC power loss
COM ERROR	

۱) AIR FAIL / O_2 FAIL
Supplied pressure of Air and O_2 is low. Check the Air and O_2 line.

۲) AIR OBST(Air Obstructed tube)
It is problem between breathing circuit and patient. Check the breathing circuit.

۳) VENT INOP(Vent in- operation)
The ventilator is abnormal status. Check the all ventilator system.

۴) O_2 SENSOR ERR
It is problem O_2 sensor. Check O_2 sensor.

۵) CIRCUIT OPEN
It is problem between breathing circuit and patient. Check the breathing circuit.

۶) BATTERY MODE
There is not connected to AC power. DC power is working.

۷) COM ERROR
Between DSC and Pneumatic module, communication error is occurred. Check the all ventilator system.

Appendix ٩٠
A. Operating theory ٩٠
B. Communications ٩٢
C. Parts accessories ٩5

A. Operating theory

Pneumatic System of MEKANT is composed of ٢ pcs of gas circuit. One is for Oxygen, the other is for Air. Proportional solenoid Valve (PSOLs) is the core of Pneumatic System. The PSOLs is controlled accurately by Flow sensor and Microprocessor so that provide accuracy respiration to patient.

MEKANT's Pneumatic System is divided into inspiratory module, expiratory module and patient circuit system. Inspiratory module is subdivided into Gas supply, Flow control, Safety Valve and Inspiration monitoring system.

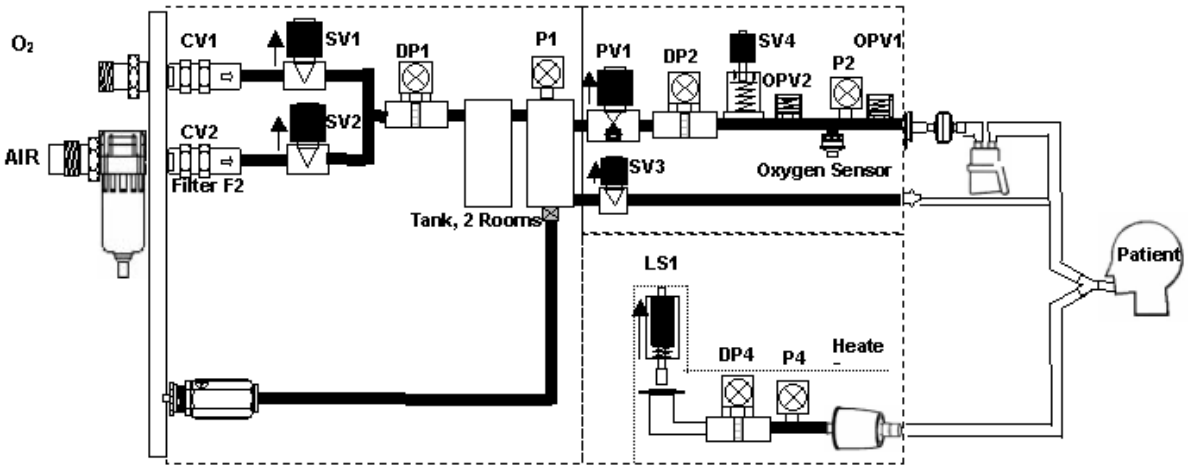


Figure A-١. PNEUMATIC Block Diagram

Blending Part

Gas supply system provides the equipment high pressure air (٣٥~٩٠ psi) and Oxygen from external source of supply, and sense that supplying pressure is not adequate. The high supplied pressure air and Oxygen is decompressed into ١٠ psi through each regulator. Adjustment pressure of Regulator should be measured by pressure valve (SV١, SV٢).

Inspiration Part

Flow control system is the most important part in Pneumatic System. This is composed of Flow sensor (DP۲) and PSOLs (PV۱). This system adjusts Tidal volume, Peak Flow, Flow pattern, Respiratory Rate, Oxygen Percentage. Control of PSOLs is done on measured value by Microprocessor. Flow sensor is Differential Pressure type.

Safety System

This is divided in Safety Valve section and Inspiration monitoring section. Safety valve section release excess pressure in the equipment and make a patient breathe with room air as a passageway.

Safety valve open and release pressure in case interior pressure reach to ۱۱۵ cmH_2O. And it is a role of passageway to connect to room air in case equipment is defect or no power, patient's expiratory limb is closed.

Inspiration monitoring section monitor gas pressure and oxygen concentration provided the patient. Monitor is measured by Absolute Pressure Transducer (PA) which is attached inspiratory Pressure Transducer (P۲). Oxygen is done by Oxygen sensor.

Expiration Part

This section is for Exhalation. PEEP/CPAP is controlled by Exhalation Valve during exhalation. Exhalation Valve of MEKANT is Active type and is similar with PSOL. This active exhalation valve makes tBiLEVEL mode possible and prevent pressure increasing suddenly.

Flow sensor (DP۴) measure Flow and Volume of patient's expiration gas, and Expiratory pressure Transducer(P۴) measure pressure.

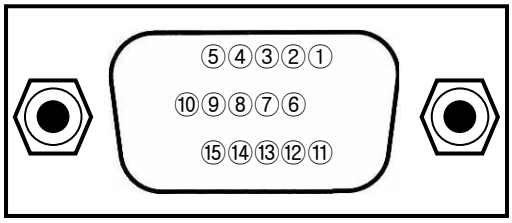
Patient Circuit System

Patient circuit system transits gas which is adjusted in Flow control system to patient, and makes patient's exhalation gas to exhalation system.

There is each Bacteria Filter on the connecting part of patient circuit system and equipment. So they make patient circuit system separate from the ventilator. It makes gas to be provided the patient heat and humidify in case humidifier is used.

B. Communications

VGA

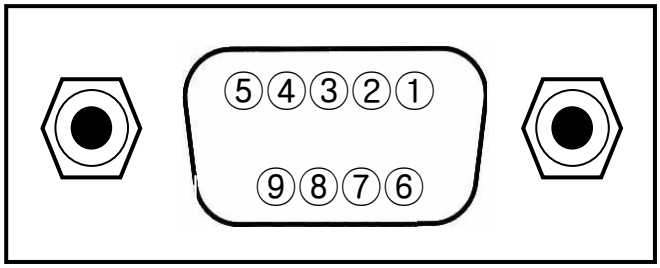


Pin	Name	Direction	Description
①	RED	→	Red Video (۷۵ohm, ۰.۷p-p)
②	GREEN	→	Green Video(۷۵ohm, ۰.۷p-p)
③	BLUE	→	Blue Video(۷۵ohm, ۰.۷p-p)
④	ID۲	←	Not connected
⑤	GND	—	Ground
⑥	RGND	—	Red Ground
⑦	GGND	—	Green Ground
⑧	BGND	—	Blue Ground
⑨	KEY		Not connected
⑩	SGND	—	Sync Ground
⑪	ID۰	←	Not connected
⑫	ID۱ or SDA	←	Not connected
⑬	HSYNC CSYNC	→ →	Horizontal Sync Composite Sync
⑭	VSYNC	←	Vertical Sync
⑮	ID۳ or SCL		Not connected

Table B-۱. VGA serial port pin out

RS-٢٣٢(serial) port

A ٩-pin male connector configured as data terminal equipment (DTE). Allowable current is ٠.٢A at ١٠V DC (maximum).



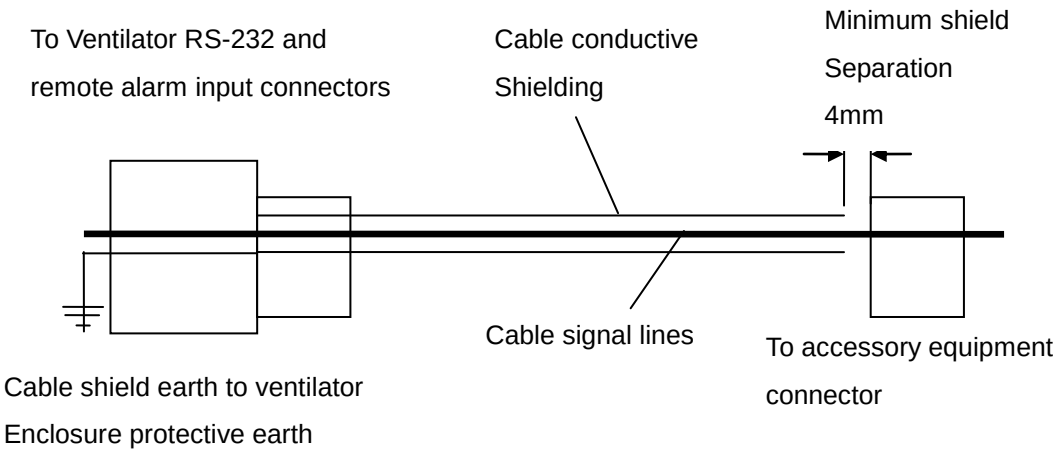
Pin	Name	Direction	Description
①	CD(Carrier Detect)		Not connected
②	RxD(Receive Data)	←	Receive data (RxD)
③	TxD(Transmit Data)	→	Transmit data (TxD)
④	DTR(DataTerminal Ready)		Not connected
⑤	SG(Signal Ground)	—	Ground(GND)
⑥	DSR(Data Set Ready)		Not connected
⑦	RTS(Request to Send)		Not connected
⑧	CTS(Clear to Send)		Not connected
⑨	RI(Ring Indicate)		Not connected

Table B-٢. RS-٢٣٢ serial port pin out

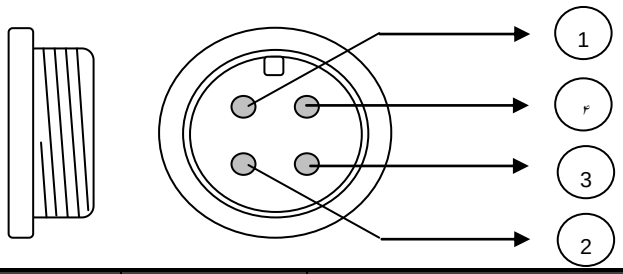
Communication capabilities (cont)

NOTE :

The connection of accessories or equipment to the ventilator's RS-٢٣٢ and remote alarm ports requires electrical separation of conductive earth (ground) connections between different items of equipment of a system. The system cable assembly shielding can interconnect the ventilator and other equipment, increasing the risk of excessive enclosure leakage current from external equipment. For safe connection, the shield conductor must have separation of ٤mm between the equipment and ventilator conductors, as show below:



LCD MONITOR POWER SUPPLY Connector



Pin	Name	Direction	Description
①	NC		Not connected
②	GND		GND
③	+VCC(+١٢V/٥A)		١٢V/ Max ٥A, OUTPUT LCD MONITOR POWER SUPPLY
④	NC		Not connected

Table B-٣. LCD Monitor Power Connector port pin out

C. Parts accessories

▣ STANDARD

Item	Photo	Part Number	Q'ty	Description
Circuit Arm		١۴٠۴٠٣۵ ٢٠	١	
High Pressure Hose		١۴١۴٠٠٠ ٢٠	١	Air Gas / Yellow
		١۴١۴٠٠٠ ٣٠	١	O٢ Gas / Green
Display Panel Cable		١۴٢۴٠١۶ ۶٠	١	
O٢ Sensor		١۴٠۵٠٠١ ٠٠	١	Inside the Factory
PEEP Silicone Plate		١۴٠۶٠١۶ ٣٠	٢	
Test Lung		١۴٠۶٠١۴ ٢٠	١	
Operation Manual		١۴١٧٠٠٣ ٨٠	١	
Power Cord		١۴٠۶٠٠۵ ٣٠	١	٣m, ٢٢٠VAC

Ground Cable		١۴١٣٠٠٢٠٠	١	
Fuse		١۴١٣٠٠١٧٠	٢	INLET ٥٠T ۶.٣A ٢٥٠V ٢٠mm
Wrench Driver		١۴٠٨٠٠٧٢٠	2	
Battery		١۴٠٨٠٠٧٢٠	1	
Circuit Arm Fix Knob		١۴٠۴٠١٠٠٠	1	
53010(O-Ring)		١۴٢١٠٠۴٠٠	12	O-Ring for PEEP Module
53030(O-Ring)		١۴٢١٠٠۴١٠	3	O-Ring for PEEP Module
Monitor Fix Bolt		١۴٠٨٠٠٣٣٠	3	M5x12mm Wrench Bolt(For Monitor)
Body Cover		١٥٠٠٠٠١۶٠	1	

Contact Us

Service calls

Followings are telephone numbers and addresses for contacting various service, product supplies and sales personnel.
Reaching open a service call with MEKICS Co., Ltd., contact the numbers listed below.

MEKICS Co., Ltd.

5F, A-BLDG,WooLimLion, #144-3, Sangdaewon-dong,

Jungwon-gu, Seongnam-si, Gyeonggi-do, Korea 462-725

Tel : + 82-70-7119-2500 Fax : + 82-31-735_2761

URL : www.mek-ics.com
e-mail : service@mek-ics.com

※ In the event of a malfunction or failure, contact Service Dept. of MEKICS Co., Ltd. along with the model name, serial number, date of purchase and explanation of failure.

Authorized Representative

Pedro Pestana, Lda

Nif : 507662407

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2770-199 Paco de Arcos