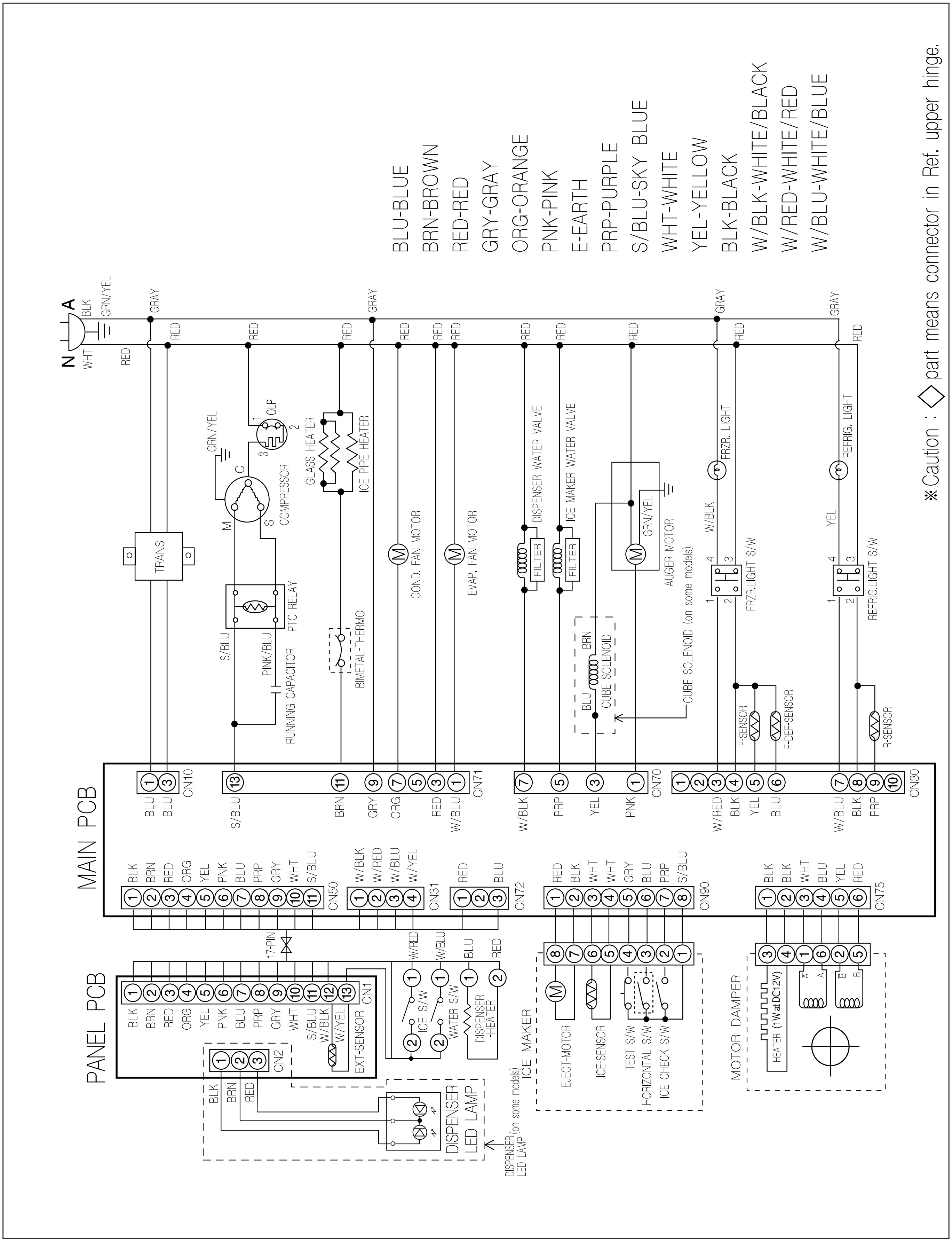
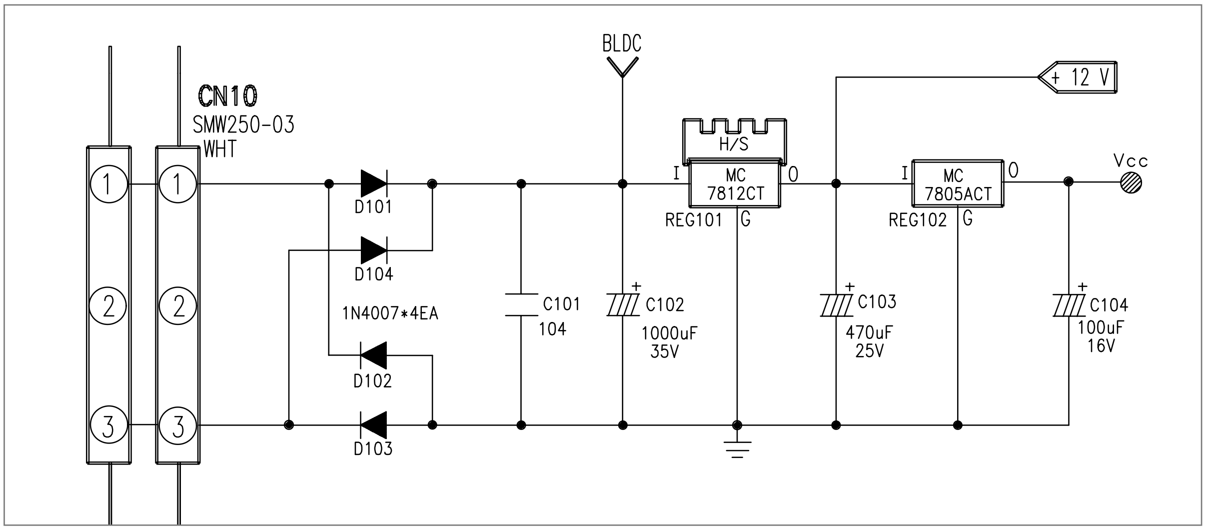
## 4. CIRCUIT DIAGRAM



# 5. OPERATION PRINCIPLES BY PARTS OF CIRCUIT

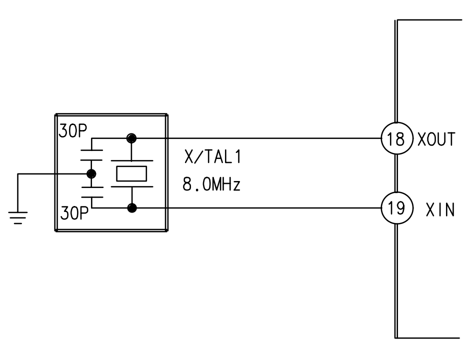
## 5-1) POWER




| Terminal | Oscillation Frequency |
|---|---|
| ● Vcc(DC 5V) | MICOM POWER AND SENSORS |
| << BLDC | BLDC MOTOR POWER(NOT USE) |
| +12V(DC 12V) | RELAY,PANEL POWER |

● When turned on, rectified AC voltage which is stepped down on 2nd transformer flows between ① and ③ at about AC 15V, goes through the diode D101 and D104 is changed to DC, and provide constant 12V. It provides 5V to MICOM and other circuits via regulator REG102 (MC7805ACT), and make entire PCB operate.

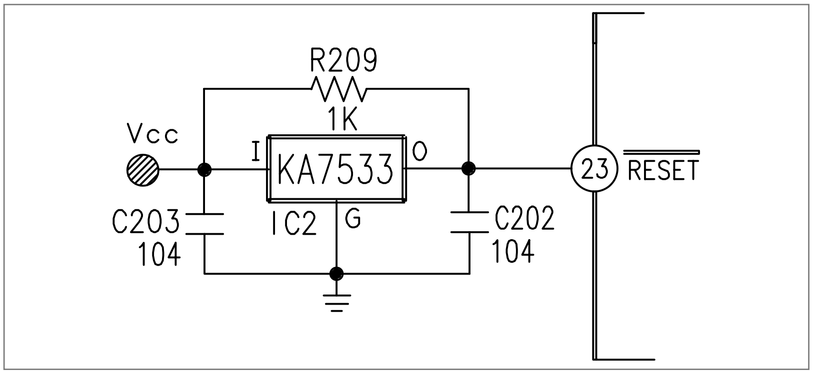
## 5-2) OSCILLATION CIRCUIT




| Terminal | Oscillation Frequency |
|---|---|
| Xin(#19) | 8.0MHz |
| Xout(#18) | 8.0MHz |

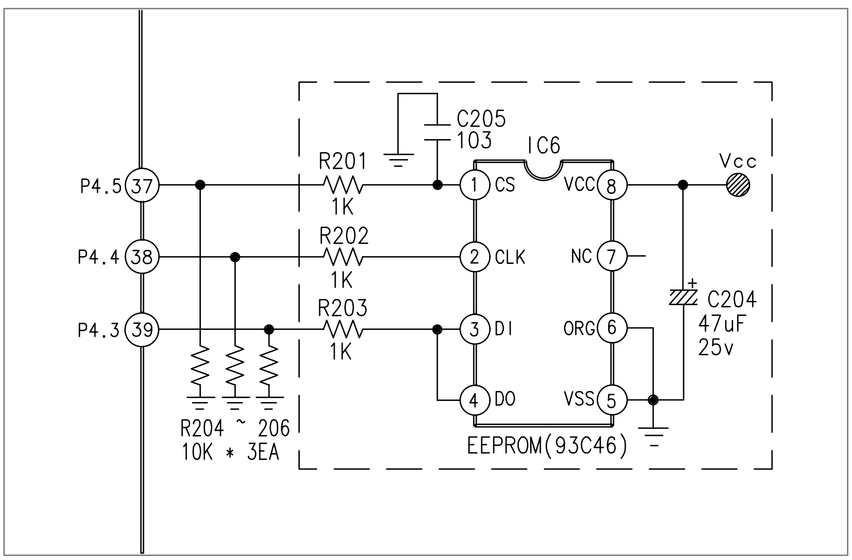
● It is an Oscillation Circuit for synchronism clock generation and time calculation on the information sending & receiving of the MICOM internal logic elements and when specifications for Resonator change, the timing system of MICOM changes resulting in errors. (Rated parts must be used)

## 5-3) RESET CIRCUIT



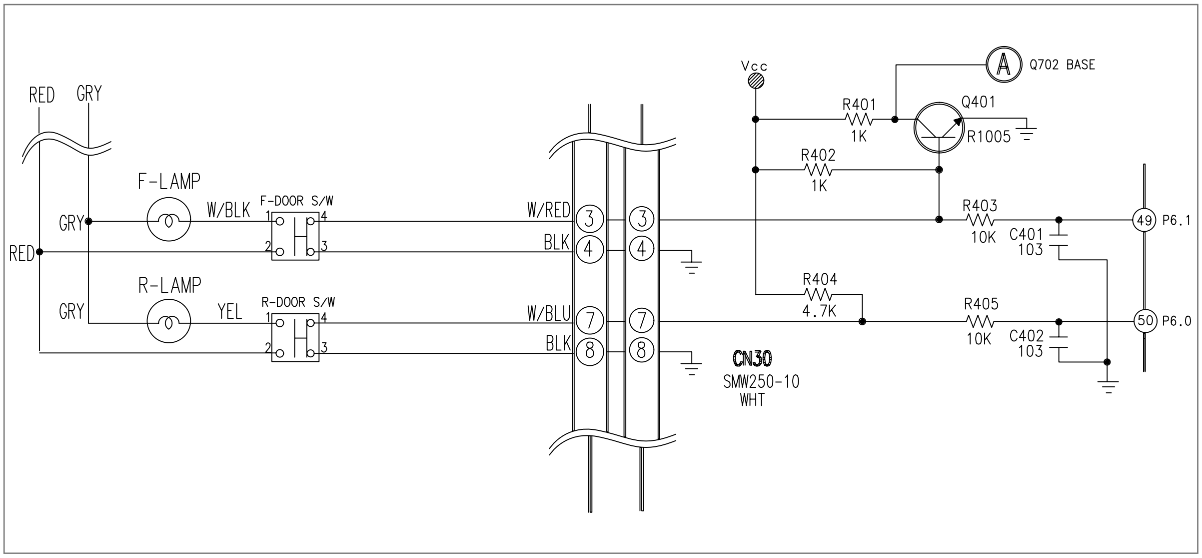

- RESET Circuit allows the whole program to go back to the initial setting by initializing parts such as the RAM in MICOM with the power supply into MICOM or with an instant power failure.
  Upon the power supply, the reset terminal voltage becomes "LOW" for several tens of $\mu s$ compared to Vcc voltage(DC 5V) at MICOM, and it maintains "HIGH"(Vcc Voltage) during normal operation.
  But, when Vcc drops down to 3.4~3.7V, the reset terminal voltage becomes "LOW".

## 5-4) EEPROM DETECTION CIRCUIT




- A semiconductor memory EEPROM stores data remembering previous settings regardless of power-off, which are indispensable especially in power fluctuating areas. Also, EEPROM sets and uses other options in principle.

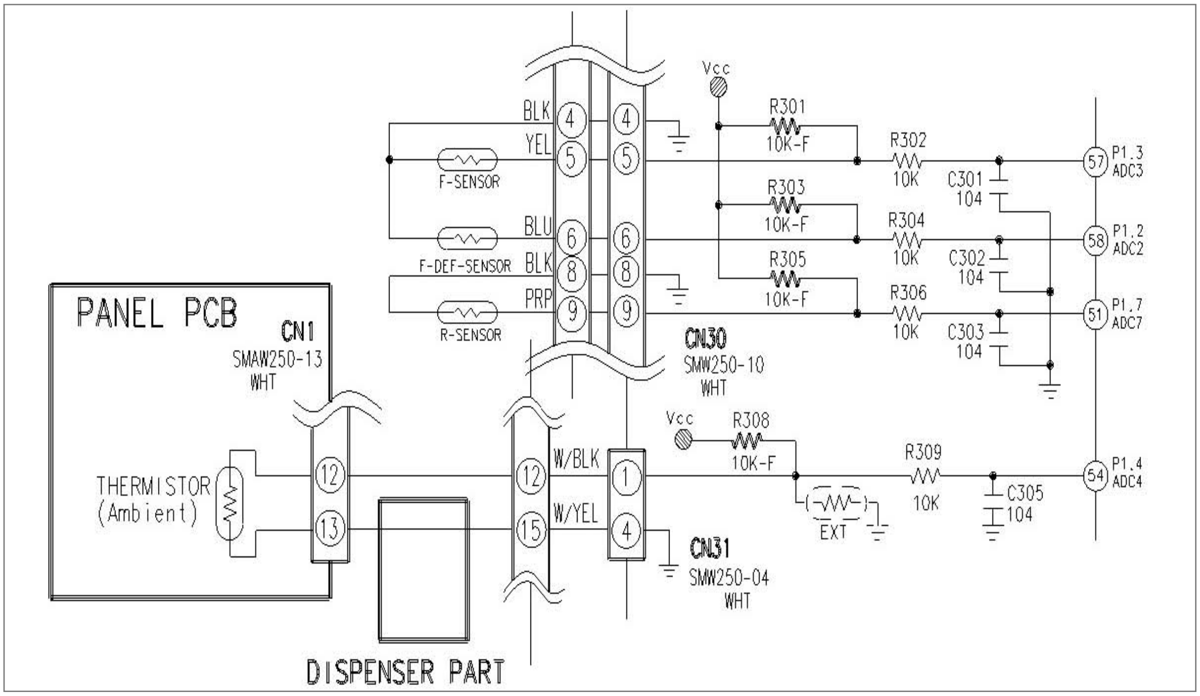
## 5-5) DOOR SWITCH DETECTON CIRCUIT




1) If R-Door is opened, the contact point of the door switch (4-3) becomes open, and the current of PCB line comes through R404 and R405 and provides 5 volt which is recognized as door is opened, and turn off the fan at different load. When the door is closed, the voltage goes out from R404 to Switch, the MICOM is applied with OV and the door is recognized as closed.
2) If F-Door is opened, the contact point of the door switch (4-3) becomes open, and the current of PCB line comes through R402 and R403 and provides 5 volt which is recognized as door is opened, and turn off the fan at different load. When the door is closed, the voltage goes out from R402 to Switch, the MICOM is applied with OV and the door is recognized as closed.
3) Q401 is the circuit to turn off the auger motor operation when the door is opened. If the door is closed, Vcc voltage of R402 works as ground via door switch, OV is applied to the base of Q401, and Q401 becomes operable, Vcc voltage on "A" part Q702 base works as emitter on Q401 collector and creates OV. (Check the operable condition for other parts at load terminals)
4) Condition for door open is the opposite of condition 3 above.

| Category | Door | DOOR S/W Contact Point | MICOM PORT NO | MICOM INPUT |
|---|---|---|---|---|
| F | CLOSE | CLOSE | #50 | "LOW" |
| | OPEN | OPEN | | "HIGH" |
| R | CLOSE | CLOSE | #49 | "LOW" |
| | OPEN | OPEN | | "HIGH" |

## 5-6) TEMP SENSING CIRCUIT




1) Sensor uses a thermistor which has a temp coefficient of negative resistance and controls resistance. When the heat goes up, the resistance gets down and vice versa. R302, 4, 6, 9 and C301~C303, C305 are parts for noise prevention but they are not related to temp sensing characteristics.

2) If Vf is the incoming voltage to MICOM in case of F-Sensor, Vf equals (Rth * Vcc)/ ((R301 + Rth). Where Rth is resistance of THERMISTOR corresponding to Temp. Please refer to the Appendix Temp-to-Sensor Resistance/Voltage conversion table(Temp-to-MICOM Terminal Voltage included) on A/S. (Next page)

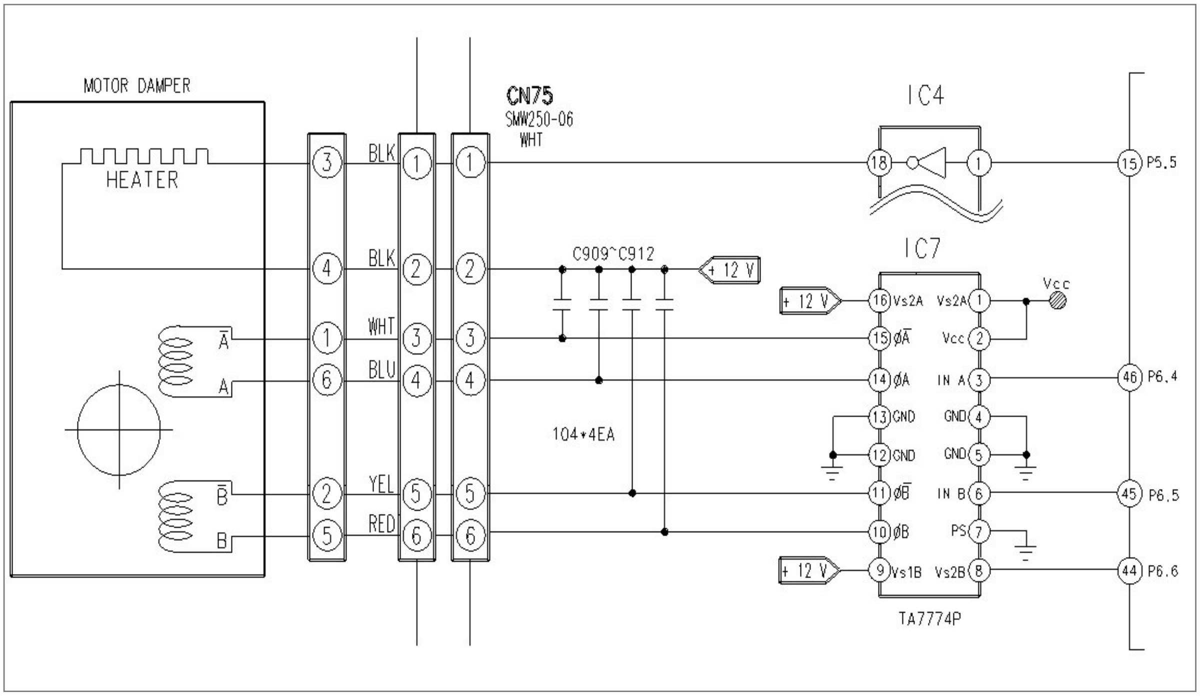
## OPERATION PRINCIPLES BY PARTS OF CIRCUIT

✻ Temp to Resistance of Sensor & MICOM PORT Voltage
Sensor CHIP : PX41C Standard

| Temp. | Resistance(kΩ) | Voltage(V) | Temp. | Resistance(kΩ) | Voltage(V) | Temp. | Resistance(kΩ) | Voltage(V) | Temp. | Resistance(kΩ) | Voltage(V) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| -50°F/-45.6℃ | 153319 | 4.694 | -19°F/-28.3℃ | 30752 | 3.773 | 12°F/-11.1℃ | 8200 | 2.253 | 43°F/6.1℃ | 2714 | 1.068 |
| -49°F/-45.0℃ | 144794 | 4.677 | -18°F/-27.8℃ | 29350 | 3.729 | 13°F/-10.6℃ | 7888 | 2.205 | 44°F/6.7℃ | 2627 | 1.04 |
| -48°F/-44.4℃ | 136798 | 4.659 | -17°F/-27.2℃ | 28021 | 3.685 | 14°F/-10.0℃ | 7590 | 2.158 | 45°F/7.2℃ | 2543 | 1.014 |
| -47°F/-43.9℃ | 129294 | 4.641 | -16°F/-26.7℃ | 26760 | 3.64 | 15°F/-9.4℃ | 7305 | 2.111 | 46°F/7.8℃ | 2462 | 0.988 |
| -46°F/-43.3℃ | 122248 | 4.622 | -15°F/-26.1℃ | 25562 | 3.594 | 16°F/-8.9℃ | 7032 | 2.064 | 47°F/8.3℃ | 2384 | 0.963 |
| -45°F/-42.8℃ | 115631 | 4.602 | -14°F/-25.6℃ | 24425 | 3.548 | 17°F/-8.3℃ | 6771 | 2.019 | 48°F/8.9℃ | 2309 | 0.938 |
| -44°F/-42.2℃ | 109413 | 4.581 | -13°F/-25.0℃ | 23345 | 3.501 | 18°F/-7.8℃ | 6521 | 1.974 | 49°F/9.4℃ | 2237 | 0.914 |
| -43°F/-41.7℃ | 103569 | 4.56 | -12°F/-24.4℃ | 22320 | 3.453 | 19°F/-7.2℃ | 6281 | 1.929 | 50°F/10.0℃ | 2167 | 0.891 |
| -42°F/-41.1℃ | 98073 | 4.537 | -11°F/-23.9℃ | 21345 | 3.405 | 20°F/-6.7℃ | 6052 | 1.885 | 51°F/10.6℃ | 2100 | 0.868 |
| -41°F/-40.6℃ | 92903 | 4.514 | -10°F/-23.3℃ | 20418 | 3.356 | 21°F/-6.1℃ | 5832 | 1.842 | 52°F/11.1℃ | 2036 | 0.846 |
| -40°F/-40.0℃ | 88037 | 4.49 | -9°F/-22.8℃ | 19537 | 3.307 | 22°F/-5.6℃ | 5621 | 1.799 | 53°F/11.7℃ | 1973 | 0.824 |
| -39°F/-39.4℃ | 83456 | 4.465 | -8°F/-22.2℃ | 18698 | 3.258 | 23°F/-5.0℃ | 5419 | 1.757 | 54°F/12.2℃ | 1913 | 0.803 |
| -38°F/-38.9℃ | 79142 | 4.439 | -7°F/-21.7℃ | 17901 | 3.208 | 24°F/-4.4℃ | 5225 | 1.716 | 55°F/12.8℃ | 1855 | 0.783 |
| -37°F/-38.3℃ | 75077 | 4.412 | -6°F/-20.6℃ | 17142 | 3.158 | 25°F/-3.9℃ | 5000 | 1.675 | 56°F/13.3℃ | 1799 | 0.762 |
| -36°F/-37.8℃ | 71246 | 4.385 | -5°F/-20.0℃ | 16419 | 3.107 | 26°F/-3.3℃ | 4861 | 1.636 | 57°F/13.9℃ | 1745 | 0.743 |
| -35°F/-37.2℃ | 67634 | 4.356 | -4°F/-45.6℃ | 15731 | 3.057 | 27°F/-2.8℃ | 4690 | 1.596 | 58°F/14.4℃ | 1693 | 0.724 |
| -34°F/-36.7℃ | 64227 | 4.326 | -3°F/-19.4℃ | 15076 | 3.006 | 28°F/-2.2℃ | 4526 | 1.558 | 59°F/15.0℃ | 1642 | 0.706 |
| -33°F/-36.1℃ | 61012 | 4.296 | -2°F/-18.9℃ | 14452 | 2.955 | 29°F/-1.7℃ | 4369 | 1.52 | 60°F/15.6℃ | 1594 | 0.688 |
| -32°F/-35.6℃ | 57977 | 4.264 | -1°F/-18.3℃ | 13857 | 2.904 | 30°F/-1.1℃ | 4218 | 1.483 | 61°F/16.1℃ | 1547 | 0.67 |
| -31°F/-35.0℃ | 55112 | 4.232 | 0°F/-17.8℃ | 13290 | 2.853 | 31°F/-0.6℃ | 4072 | 1.447 | 62°F/16.7℃ | 1502 | 0.653 |
| -30°F/-34.4℃ | 52406 | 4.199 | 1°F/-17.2℃ | 12749 | 2.802 | 32°F/0.0℃ | 3933 | 1.412 | 63°F/17.2℃ | 1458 | 0.636 |
| -29°F/-33.9℃ | 49848 | 4.165 | 2°F/-16.7℃ | 12233 | 2.751 | 33°F/0.6℃ | 3799 | 1.377 | 64°F/17.8℃ | 1416 | 0.62 |
| -28°F/-33.3℃ | 47431 | 4.129 | 3°F/-16.1℃ | 11741 | 2.7 | 34°F/1.1℃ | 3670 | 1.343 | 65°F/18.3℃ | 1375 | 0.604 |
| -27°F/-32.8℃ | 45146 | 4.093 | 4°F/-15.6℃ | 11271 | 2.649 | 35°F/1.7℃ | 3547 | 1.309 | 66°F/18.9℃ | 1335 | 0.589 |
| -26°F/-32.2℃ | 42984 | 4.056 | 5°F/-15.0℃ | 10823 | 2.599 | 36°F/2.2℃ | 3428 | 1.277 | 67°F/19.4℃ | 1297 | 0.574 |
| -25°F/-31.7℃ | 40938 | 4.018 | 6°F/-14.4℃ | 10395 | 2.548 | 37°F/2.8℃ | 3344 | 1.253 | 68°F/20.0℃ | 1260 | 0.56 |
| -24°F/-31.1℃ | 39002 | 3.98 | 7°F/-13.9℃ | 9986 | 2.498 | 38°F/3.3℃ | 3204 | 1.213 | 69°F/-45.6℃ | 1225 | 0.546 |
| -23°F/-30.6℃ | 37169 | 3.94 | 8°F/-13.3℃ | 9596 | 2.449 | 39°F/3.9℃ | 3098 | 1.183 | 70°F/20.6℃ | 1190 | 0.532 |
| -22°F/-30.0℃ | 35433 | 3.899 | 9°F/-12.8℃ | 9223 | 2.399 | 40°F/4.4℃ | 2997 | 1.153 | 71°F/21.7℃ | 1157 | 0.519 |
| -21°F/-29.4℃ | 33788 | 3.858 | 10°F/-12.2℃ | 8867 | 2.35 | 41°F/5.0℃ | 2899 | 1.124 | 72°F/22.2℃ | 1125 | 0.506 |
| -20°F/-28.9℃ | 32230 | 3.816 | 11°F/-11.7℃ | 8526 | 2.301 | 42°F/5.6℃ | 2805 | 1.095 | 73°F/22.8℃ | 1093 | 0.493 |

# OPERATION PRINCIPLES BY PARTS OF CIRCUIT

## 5-7) DAMPER CIRCUIT




1) The temperature of R-room is controlled by opening and closing of damper with stepping motor, supplying & blocking cold air.

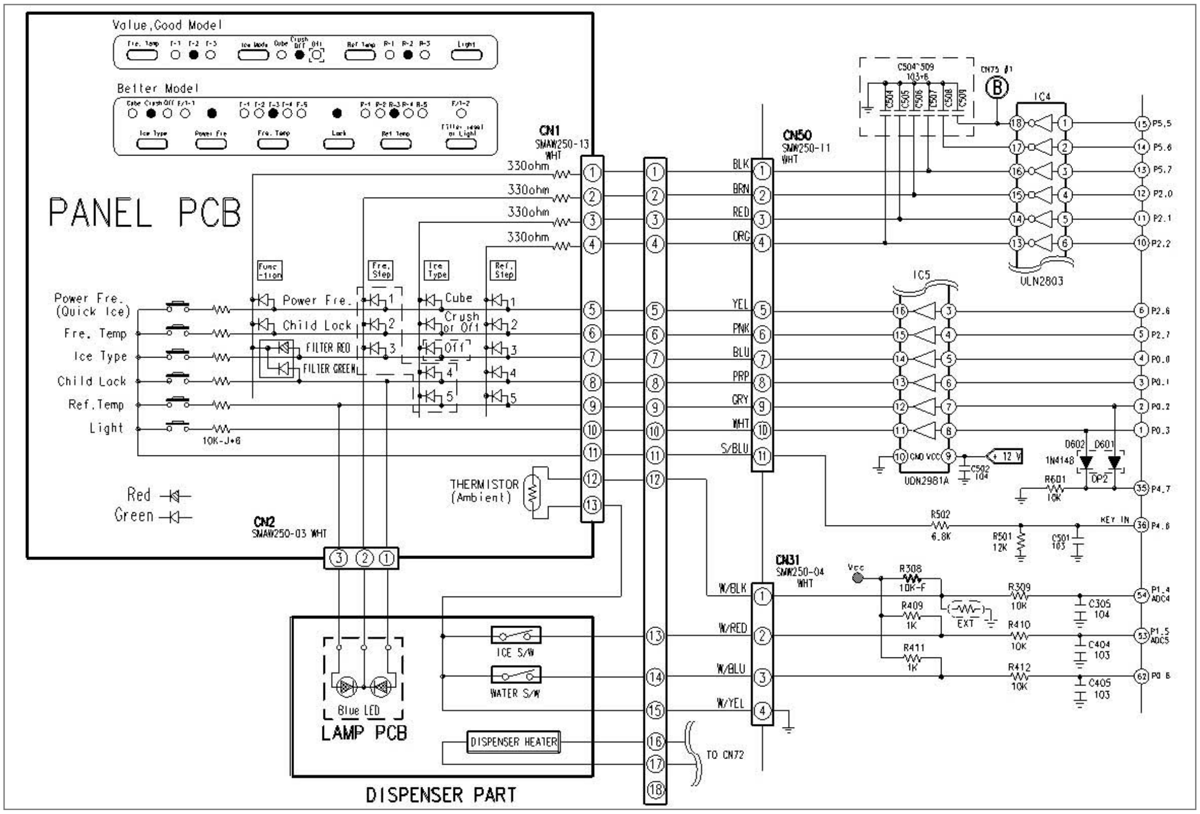
2) TA7774P (IC07) operates the damper. TA7774P is the driver IC only for step motor. If the regular signal is provided to TA7774P from Micom, send combined signal to Quad-Polar step motor to rotate on certain direction. This makes clockwise or counter clockwise rotation to make the damper open or close.

3) Since the damper always touches the cold air, DC 12V/1W heater is installed, always on to prevent the malfunction from moisture and is controlled on conditions. (Operation conditions can be changed). Micon #15 pin connected to IC4 controls the damper heater like category 3.

## 5-8) DISPLAY Circuit

1) KEY SCAN

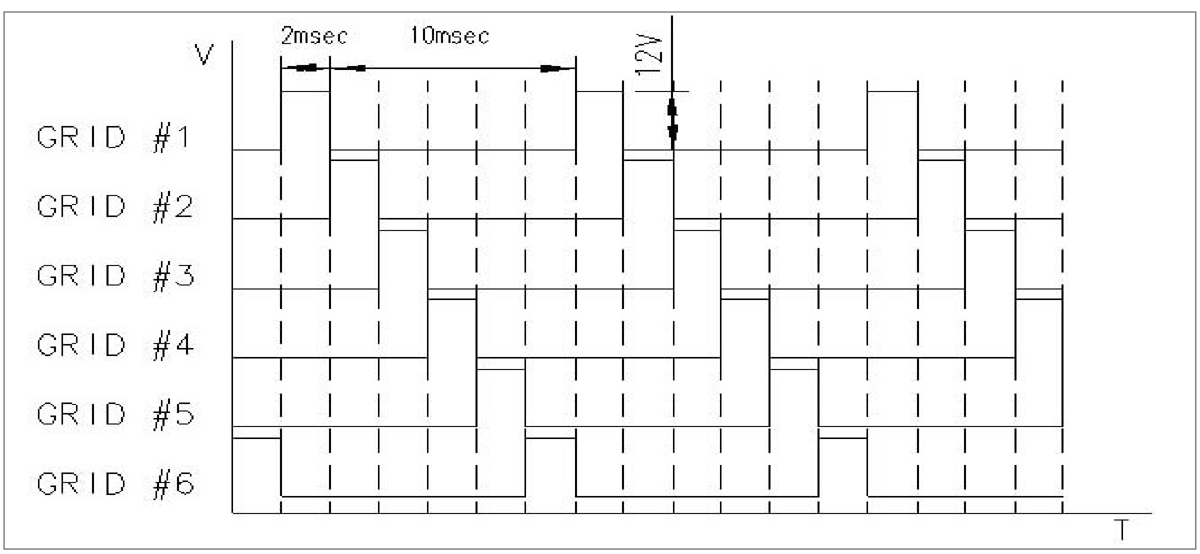
When Grid #6 is output, this signal goes through PCB resistance 10 ㏀ and provided to power frequency. When the switch is pressed, R502(6.8 ㏀) and R501 (12 ㏀) decrease the signal and less than 5.1V peak to peak signal is provided to MICOM, the MICOM recognizes the grid #6 is provided, and change the function corresponding to switch key. [Refer the circuit diagram below]



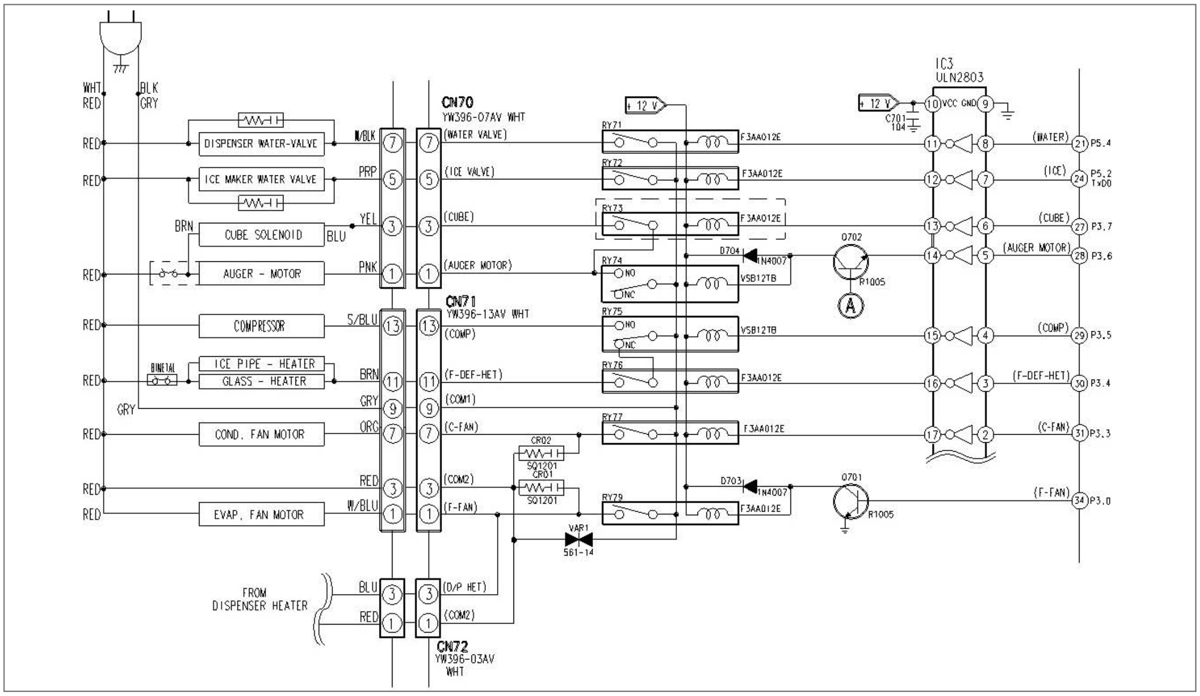
2) DISPLAY OPERATION

Like the signal diagram below, Micom sends “ high ” signal through MICOM 6 terminals of NO #1→ 2 → 3 → 4 → 5 → 6 for 2ms every 12ms. This signal goes to output terminal via input terminal of IC5 (KID65783AP or TD62783AP). Output wave always goes through LED input terminal with DC11~12V on every period. At this time, if SINK signal comes out at IC4, DC11~ 12V is applied to LED input terminal and output terminal sinks to OV which turn on LED for 2ms For example, to turn on "Power Fre." LED, IC4 #16 pin sinks to 0V when IC5 #16 becomes DC 11~12V making "Power Fre" LED turn on.

✻ GRID WAVE PATTERN



## 5-9) Load Control Circuit

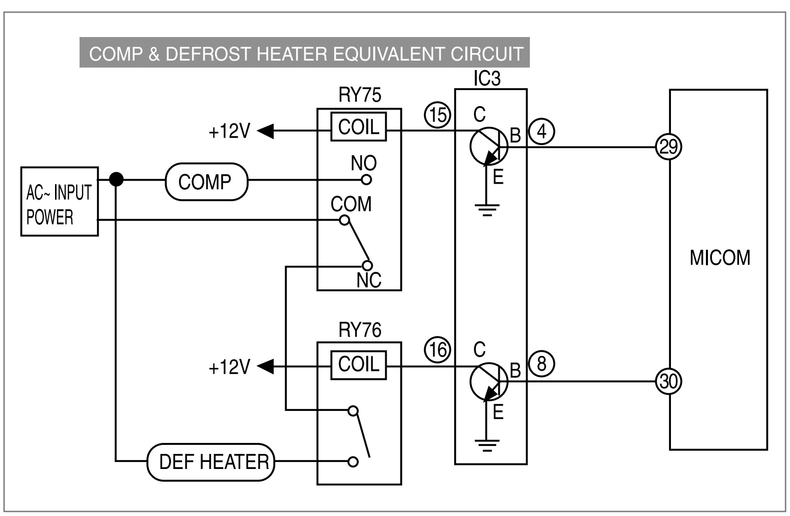



1) Main PCB processes most of the load control for electronic refrigerators.

2) Compressor, F-Room, defrost heater, and other functions are controlled with relay.

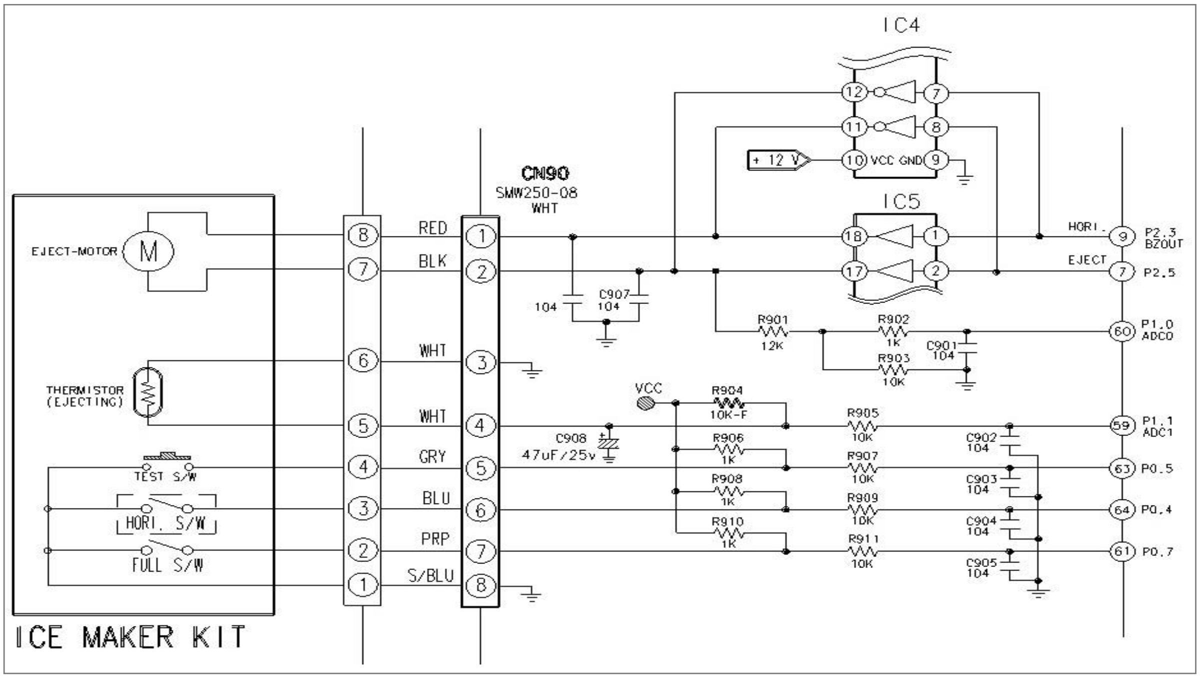
3) For example, to operate compressor, MICOM 29 pin outputs high (5V) signal which goes into IC3 Pin #4. The IC3 pin NO 4 plays the same role as the base of NPN TR. The pin #14 works as collector of TR. So, if 5V is supplied to pin #4 of IC3, the pin #15 turned on and connected to the ground. Then, the relay RY75 and coil connected to the pin #15 of IC3 becomes low (OV) and +12V (opposite side of coil) flows to the pin #15 of IC3 via coil and goes into the ground. While current flows to the coil, the magnetic power arise, it turns on the secondary contact point inside of RY75, and operates when the AC power is supplied to the both side of comp. When MICOM #29 Pin becomes Low(0V), IC3 #4 Pin becomes Low which makes Power cut and current of RY75 RELAY cut. So, secondary contact becomes off due to magnetic field cut, which makes Comp off.

4) All other loads work basically on same principle, defrost heater operates only on the condition that the compressor is turned off like the circuit above, and connected like the equivalent circuit below.




* Q710 is connected to the F door switch to prevent PL accident due to continuous operation of motor when the auger motor control circuit is not working properly. It must be turned off when the door is opened.

## 5-10) ICE MAKER OPERATION CIRCUIT



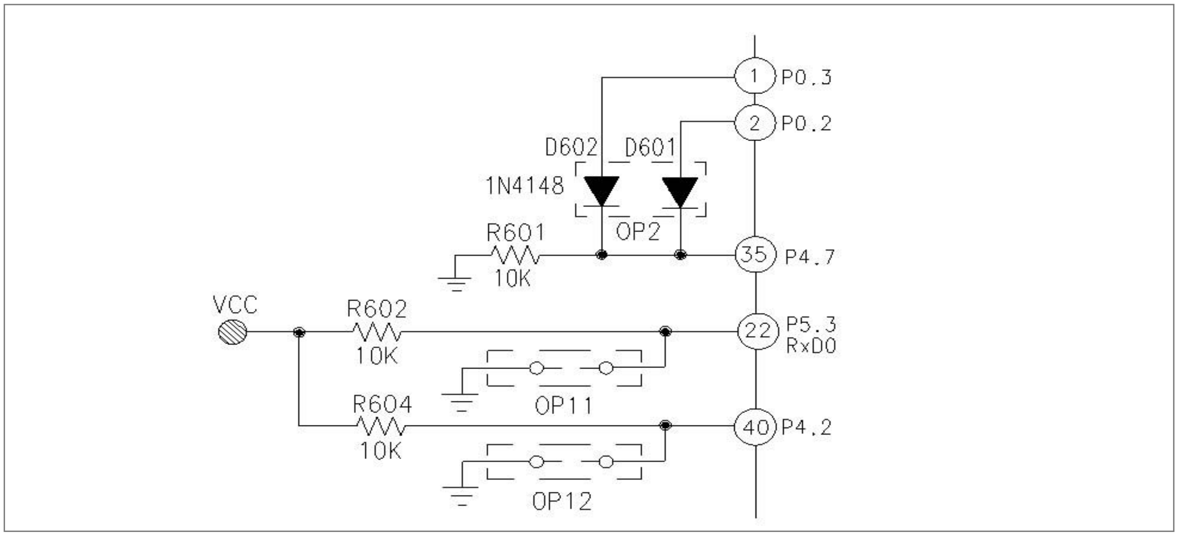

1) The ice maker circuit above is to control the ice maker kit installed on the F room.

2) This circuit is the hardware to control ejection and horizontal positioning, ice making temperature detection and full icing detection. Temperature detection circuit is the same as temperature detection circuit on 4-6 and the explanation will be skipped and only the ejection circuit will be explained. If MICOM PORT #7 is outputted with High to rotate motor in ejection direction and the pin #2 of IC5 is inputted, 12V is outputted on pin #17 of IC5, goes to motor and supplied to pin #11 of IC4. As pin #8 of IC4 and eject MICOM port #7 are connected in common, 11 output port of IC4 gets on and the current flows into Ground making motor rotates. This motor rotates the gear and rotates the ejection tray. The tray twists to separate the ice from the tray and return to the horizontal state.

3) For restoration, motor stops for 2 seconds when the ejection is completed and to rotate in opposite direction, output horizontal MICOM port with high and perform horizontal positioning.

4) The test S/W is off in normal cases and MICOM PORT 63 stays high. When necessary, press the switch for more than 1.5 seconds making forced ejection executed. Full S/W has a lever that detects the amount of ice on ice-maker kit and based on the status of MICRO S/W connected to the lever, if the ice is full on the container, ejection is not executed, and only if it is off (MICOM PORT 61 is high), the ejection is executed.

## 5-11) OPTION Circuit




- This circuit operates with the initial power on, uses DIODE (1N4148) or JUMPER WIRE.
  To modify option circuit, Power must be turned off before modification and turned on after the modification.
  Refer to the table below, the default factory values are highly recommended unless exceptional cases.

| OP11, OP12 | | | |
|---|---|---|---|
| OP11 | OP12 | MODEL | FUNTION |
| ○ | ○ | RS2*11 | No Cruch, 3 Step, Light |
| ○ | ● | RS2*21 | Cruch, 3 Step, Light |
| ● | ○ | RS2*31 | Cruch, 5 Step, P/F, L/T Lock, Filter, Indicator |
| * ● Jumper USE OP2 < Water Fill Time Control Option > | | | |
| D601 | D602 | Fill Time | Remark |
| ● | ● | 5 Sec | Flow Sensor Not USE |
| ● | ○ | 6 Sec | |
| ○ | ● | 7 Sec | |
| ○ | ○ | 10 Sec | |
| * ● Diode(1N4148) USE | | | |