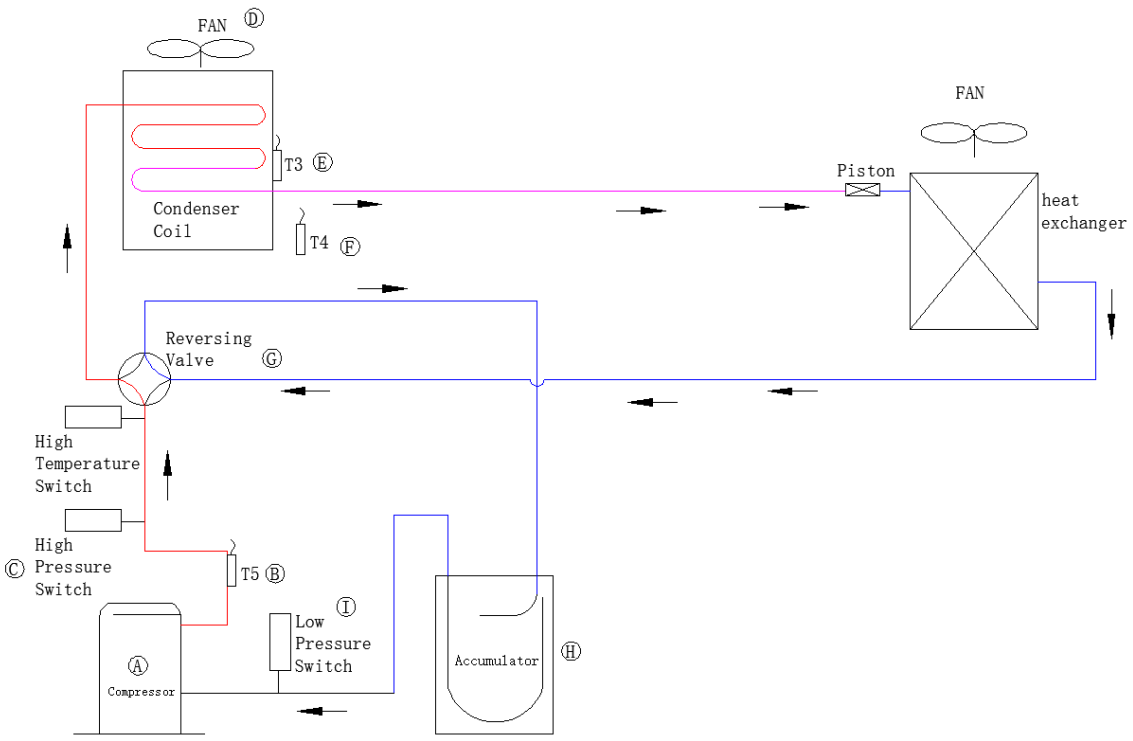
Service Manual

PART 1 Product instructions

2.1 Refrigerant Circuit

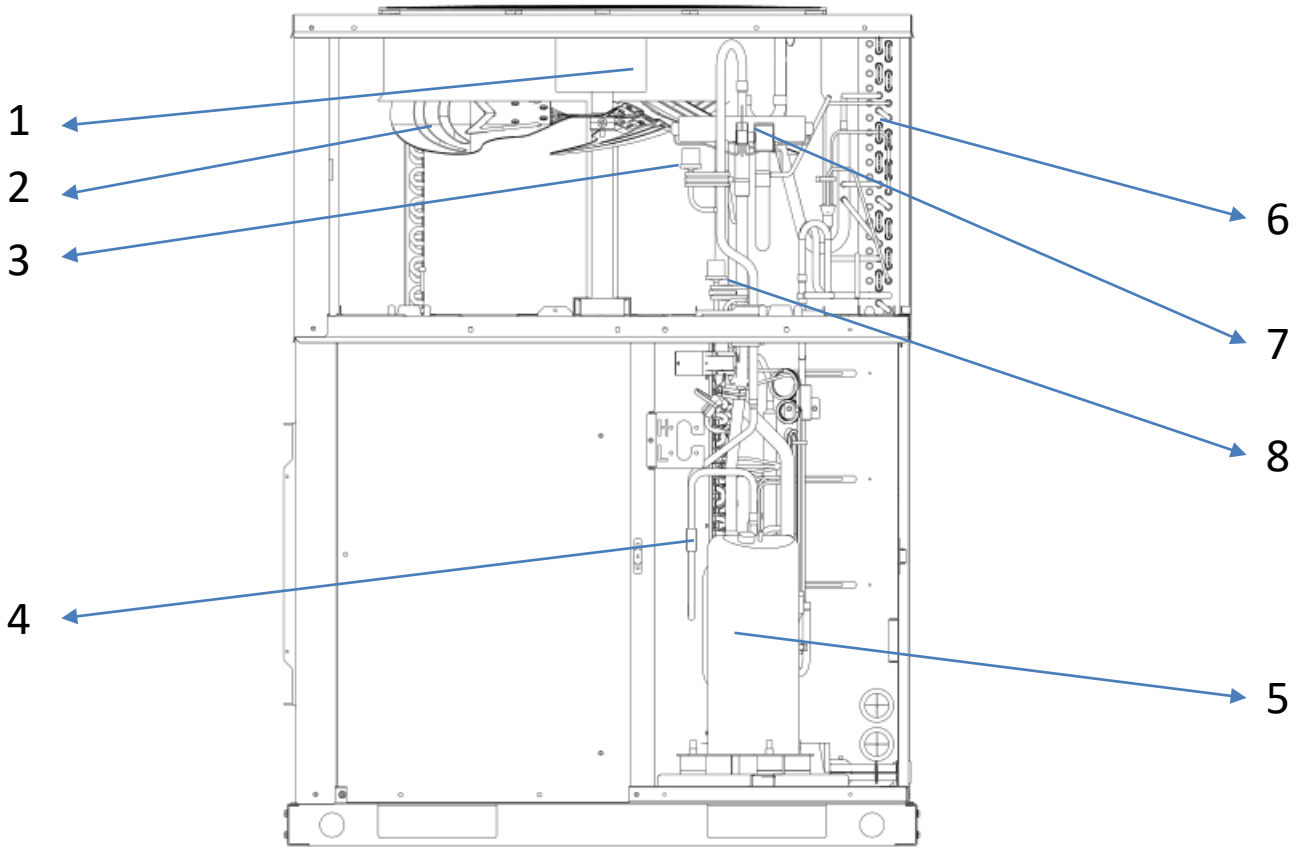
No. in diagram	Symbol	Part Name	Major function
A	Comp.	Compressor	Compresses and drives the refrigerant.
B	T5	Compressor dischare temperature sensor	Used to discharge temperature protection
C	HPS	High pressure switch	Used to high pressure protection when up to 609 PSIG and recovery when below to 464 PSIG.
D	Fan	Fan of outdoor	Used to help heat exchange by PSC motor.
E	T3	Condenser coil temperature sensor	Used to discharge temperature protection and defrost control.
F	T4	Ambient temperature sensor	Used to ambient protection and defrost control.
G	RV	The Reversing Valve	Used to switch mode between cooing and heating.
H	Accumulator	Accumulator	Store the liquid component of the refrigerant and reduce the load of the condenser.
I	LPS	Low pressure switch	Used to low pressure protection when below to 20 PSIG and recovery when up to 44 PSIG.



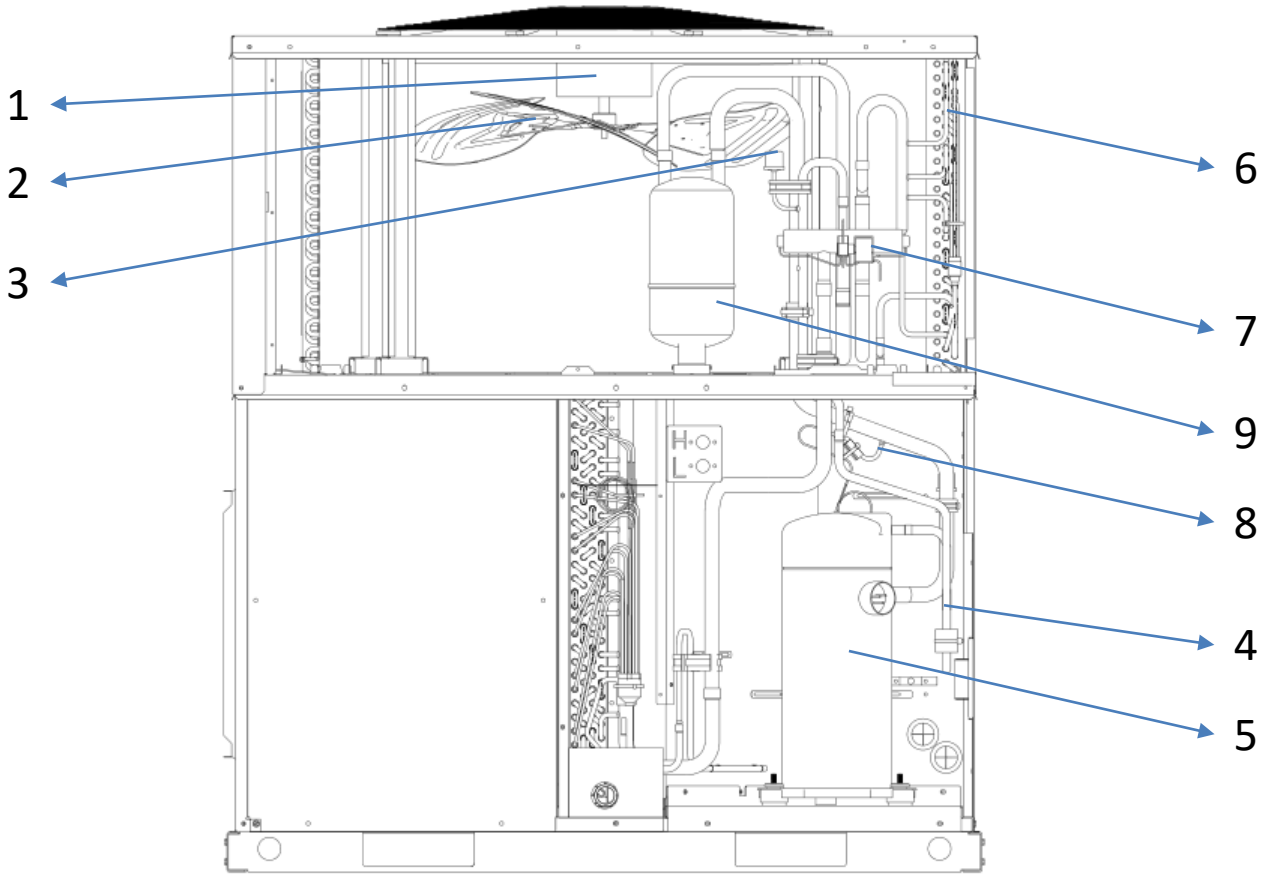
TUTTOKOOL
the best for less

2.2 Functional Part

13.4HP 71/105



13.4HP 140/160



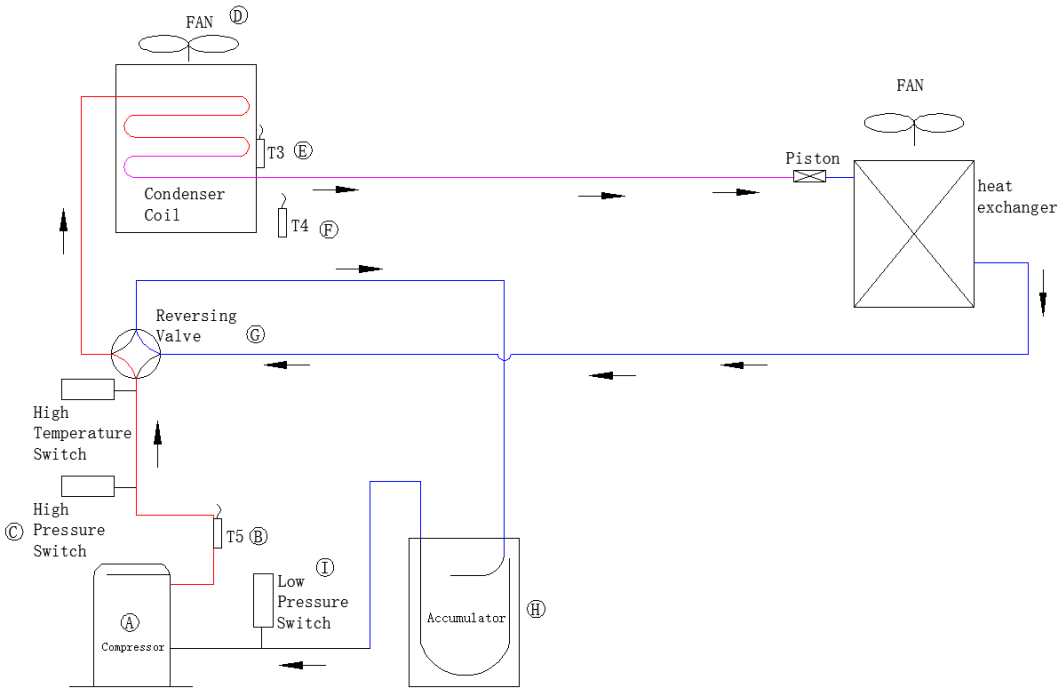
2.2 Functional Part

No. in diagram	Symbol	Part Name
1	Motor	Fan motor
2	Fan	Fan of outdoor
3	HPS	High pressure switch
4	DTS	Discharge Temperature switch
5	Comp.	Compressor
6	COIL	Condenser coil
7	RV	The Reversing Value
8	PS	Pressure Switch
9	Accumulator	Accumulator

2.3 Refrigerant Flow Chart

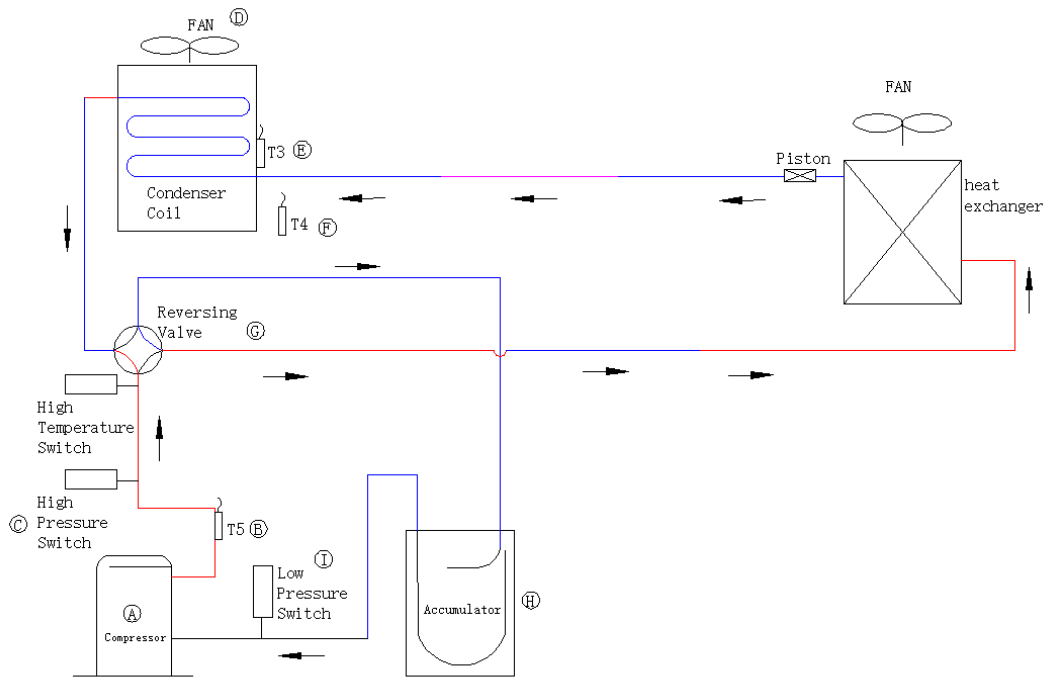
Cooling Operation/Cooling Oil Return Operation/Defrost Operation

- High pressure gas
- High pressure liquid
- Low pressure

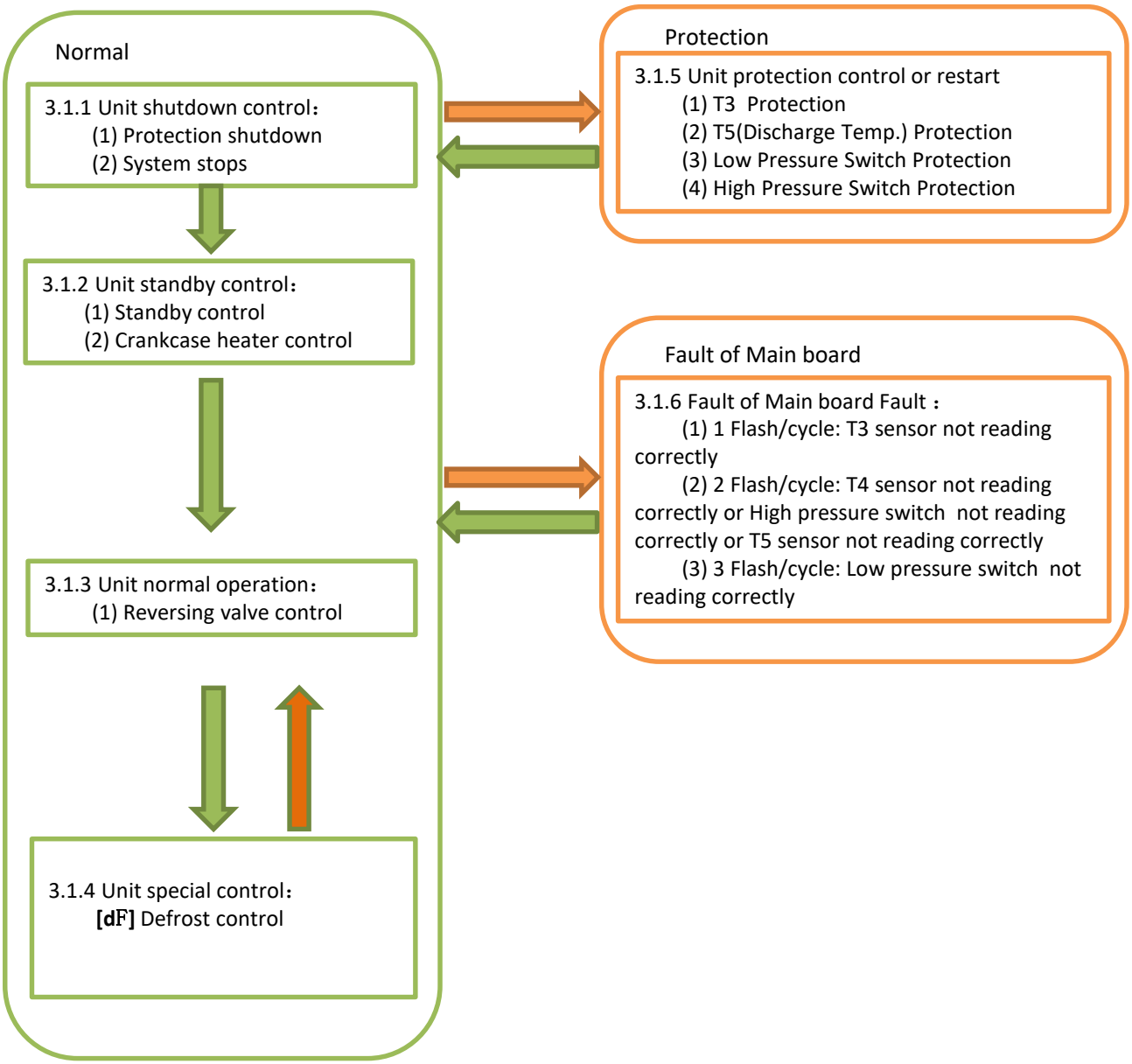


Heating Operation/Heating Oil Return Operation

- High pressure gas
- High pressure liquid
- Low pressure



3.1 Function General



3.1.1 Unit shutdown control

(1) Unit protection shutdown

To protect the outdoor unit, our system will shut down when there is something abnormal. Also the LED would show the fault code when fault present.

(2) Thermostat satisfied shutdown

Anytime system is in unit standby, LED will flash slowly (2s ON and 2s off).

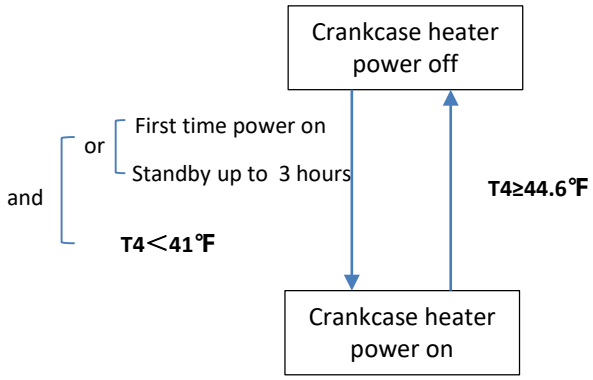
3.1.2 Unit standby control

(1) Standby control

When compressor stopped, the outdoor fan would stop immediately. Before compressor start, the outdoor fan motor will run at least 15 seconds.

(2) Crankcase heater control

Here is the condition for crankcase heater control.



T4 is the Ambient temperature .

3.1.3 Unit normal operation

(1) Reversing valve control

[Cooling]

Symbol	Part Name	Major function
RV	The Reversing Valve	OFF

[Heating]

Symbol	Part Name	Major function
RV	The Reversing Valve	ON

The heat pump need “B” signal of 24V wires.

●Cooling:

The reversing valve is off during cooling.

●Heating:

The reversing valve is on during heating and heating standby.

▲Special control: The reversing valve will delay about 1 minute when the first heating starting for reversing reliability.

3.1.4 Unit special control

[dF] Defrost control

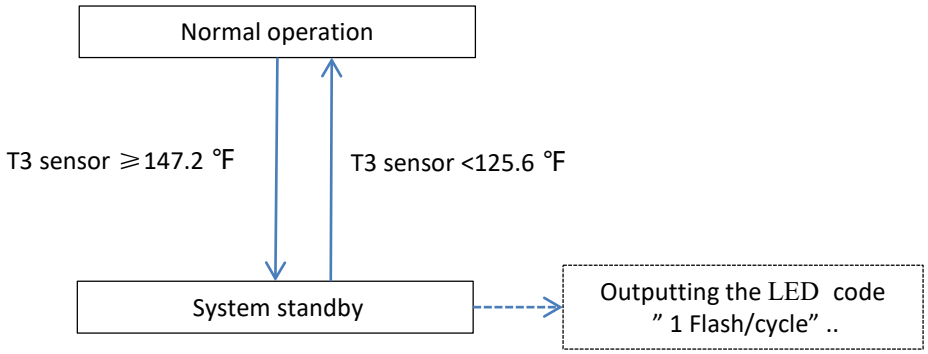
● The Demand Defrost Control (DDC) monitors the coil temperature using thermistor (T3). A second thermistor (T4) monitors outdoor ambient temperature. Based on these parameters, as well as accumulative running time and Standby time, the DDC calculates proper initiation of defrost.

●Any of three conditions is required to enter defrost:

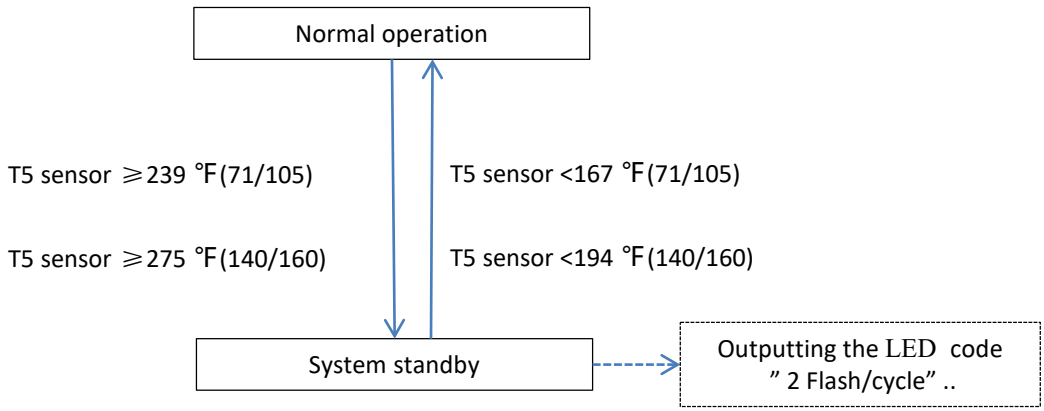
—— T3<32 ℉ and lasted for 60 minutes
—— T4<37℉ and lasted for 80 minutes
—— ”Standby time” is 2 hours, T3<28℉ when starting and lasted for 15 minutes

3.1.5 Unit protection control or restart：

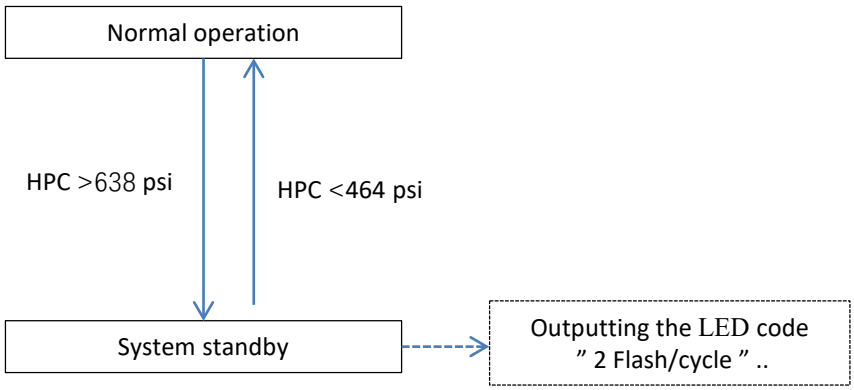
(1) **T3 Protection in cooling**



(2) **T5(Discharge Temp.) Protection**

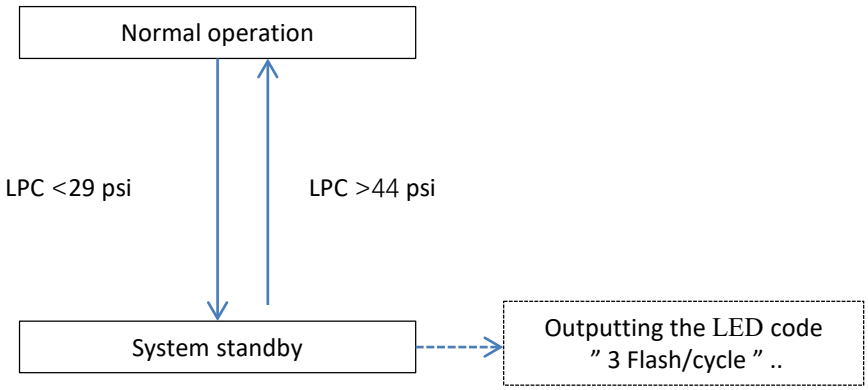


(3) **High Pressure Switch Protection**



3.1.5 Unit protection control or restart：

(3) **Low Pressure Switch Protection**

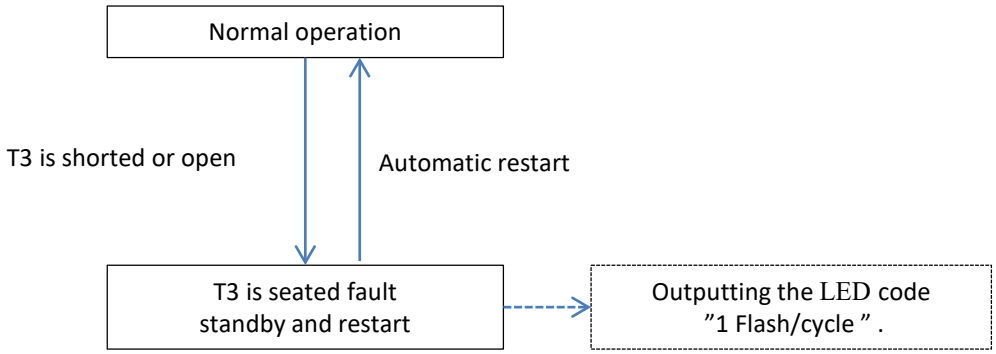


3.1.6 Fault of Main board：

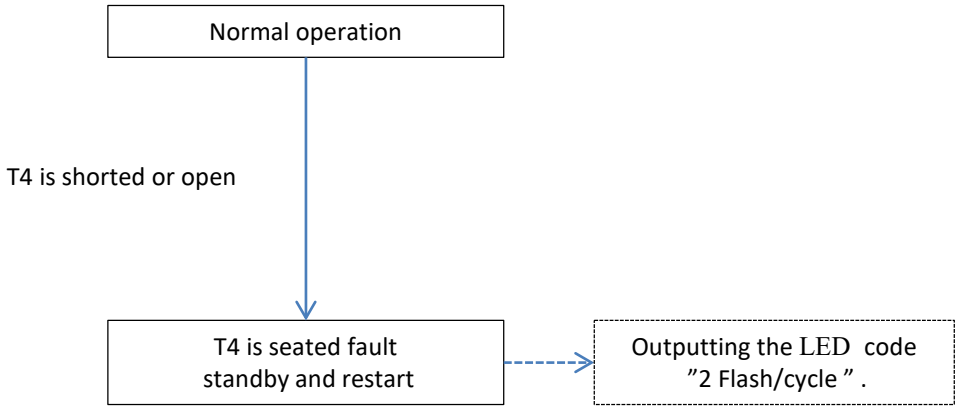
No.	Operation LED	Protection code	Protection control description	Supposed cause
1	LED2	1 Flash/cycle	T3 sensor not reading correctly in cooling	T3 sensor is not properly placed/High pressure switch fault
2	LED2	2 Flash/cycle	T4 sensor not reading correctly	T4 sensor is not properly placed/High pressure switch fault/ Discharge temp. switch open
3	LED2	3 Flash/cycle	Low pressure switch not reading correctly	Low pressure switch is not properly connected.

3.1.7 Unit Fault Control or Restart：

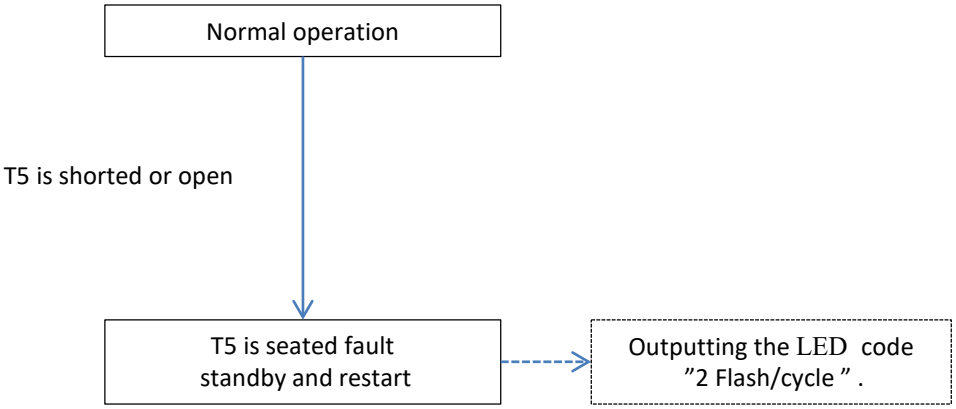
(1) T3 sensor not reading correctly in cooling



(2) T4 sensor not reading correctly

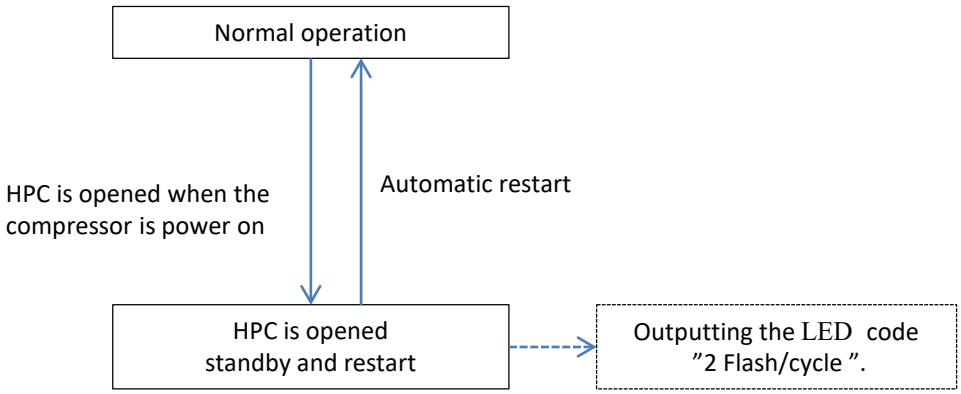


(3) T5 sensor not reading correctly

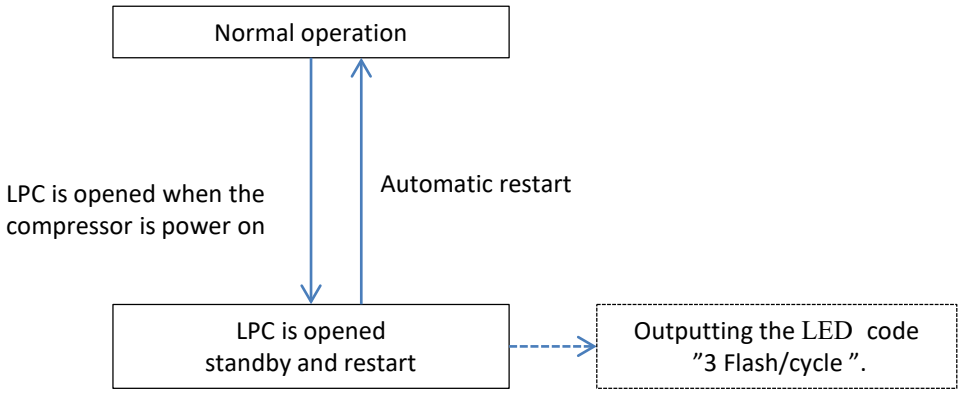


3.1.7 Unit Fault Control or Restart：

(4) HPC open



(5) LPC open



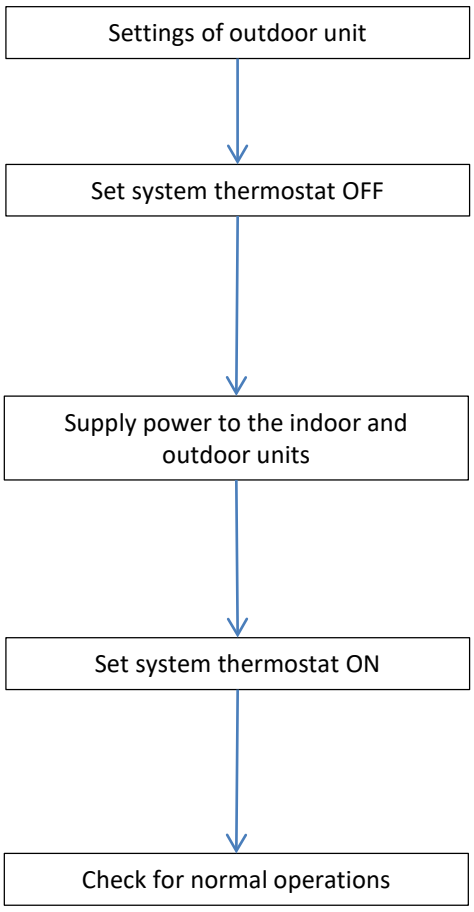
4.1 Test operation

4.1.1 Checks before test operation

No.	Checkpoints	Cautions or warnings
1	Are all units securely installed?	Dangerous for turning over during storm Possible damage to pipe connections
2	Is the earth wire installed according to the applicable local standard?	Dangerous if electric leakage occurs
3	Are the condenser unit installed according to location restrictions requirement?	Poor capacity abnormal operation
4	Are all air inlets and outlets of the indoor and outdoor units unobstructed?	Poor cooling Poor heating
5	Does the drain flow out smoothly?	Pipeline water leak
6	Is piping adequately heat-insulated?	Pipeline water leak Poor capacity
7	Do the supply power wirings connected Normally? Including the earth wiring.	Dangerous if electric leakage occurs
8	Does the earth leakage circuit breaker connected normally?	Dangerous if electric leakage occurs
9	Do the wirings of 24V signal connected according to wiring diagram? Including the thermostat wiring and setting.	abnormal operation
10	Is the supply voltage conform to the specifications on the name plate?	abnormal operation Damage unit
11	Are the cable sizes as specified and according to local regulations?	Damage of cables

4.1 Test operation

4.1.2 Turn power on



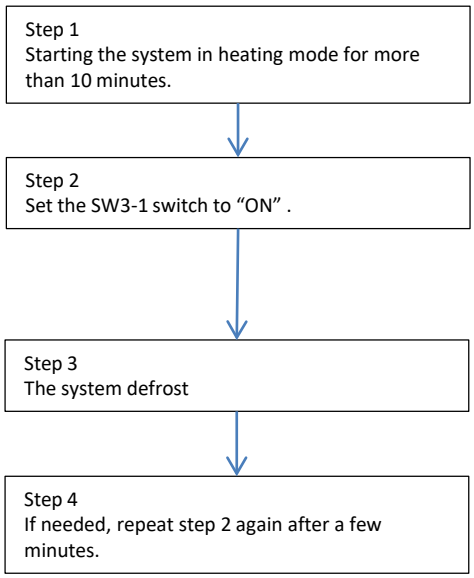
Note:
Make field setting if needed.
(For the setting procedure, refer to information in “4.2 Setting by DIP switches”)

Note:
In a normal condition, the LED flesh slowly .

Note:
Check operations
Check for the 24V signal from thermostat
Check for operation mode

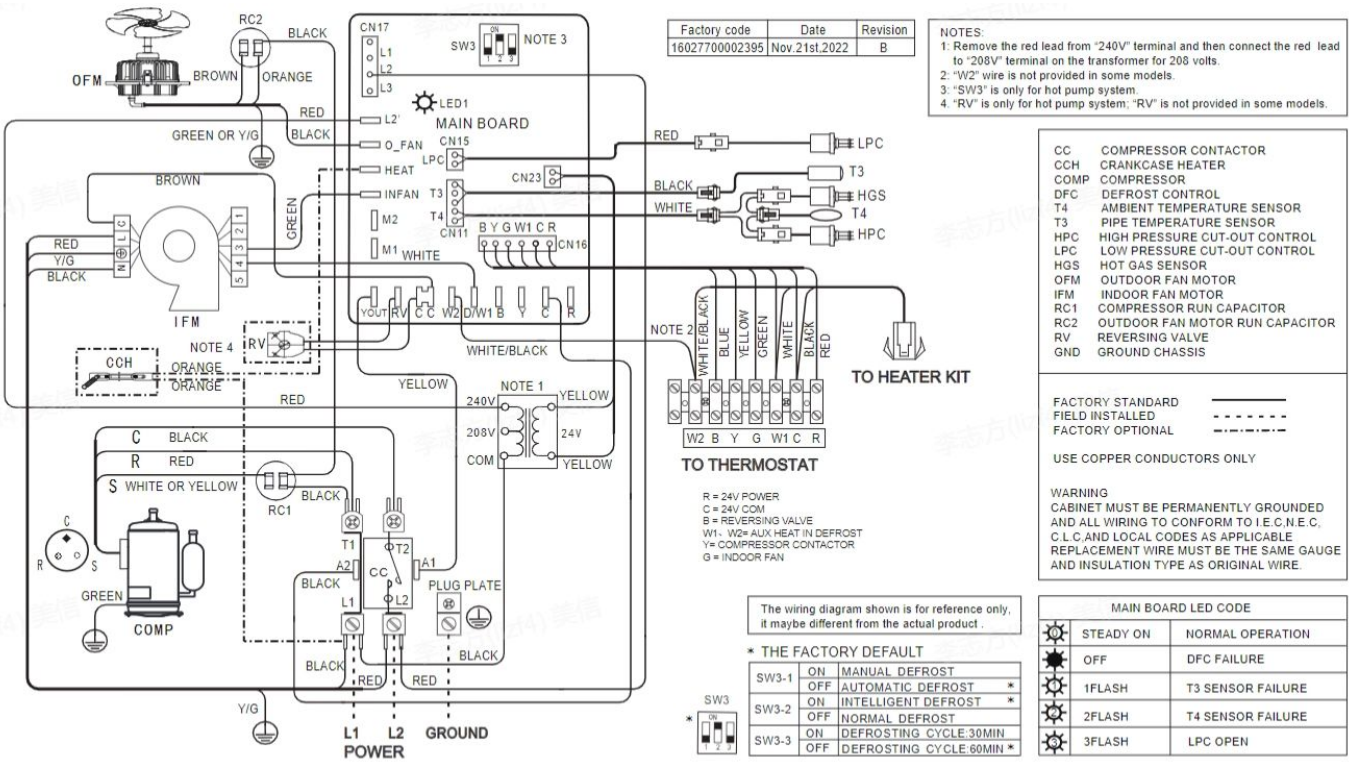
4.1 Test operation

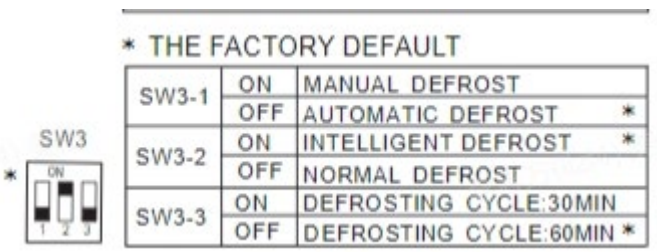
4.1.3 Manual defrost



Note:
Defrost will exit automatically.

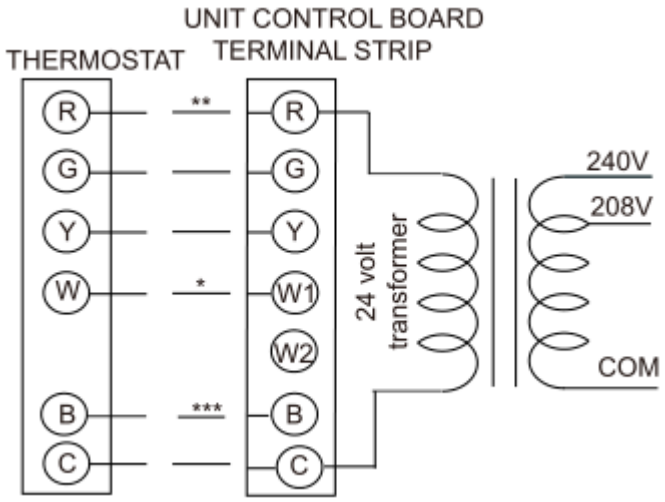
4.2 Setting by DIP switches





4.3 Thermostat

Thermostat should be mounted on an inside wall about 58” from floor and will not be affected by unconditioned air, sun and/or heat exposure. Follow the instruction carefully because there are many wiring requirements.



*** B wire be used with heat pump system only, reversing valve energizes at the heating mode, and cut off at the cooling mode.

** Minimum wire size of 18 AWG wire should be used for all field installed 24 volt wire.

* Only required on units with supplemental electric heat.

5.1 diagnosis system introduction

No.	Protection code	Protection control description	Supposed cause
1	1 Flash/cycle	T3 sensor not reading correctly in cooling	T3 sensor is not properly
2	2 Flash/cycle	T4 sensor not reading correctly	T4 sensor is not properly placed/High pressure switch fault/ Discharge temp. switch open
3	3 Flash/cycle	Low pressure switch not reading correctly	Low pressure switch is not properly connected.

Note:

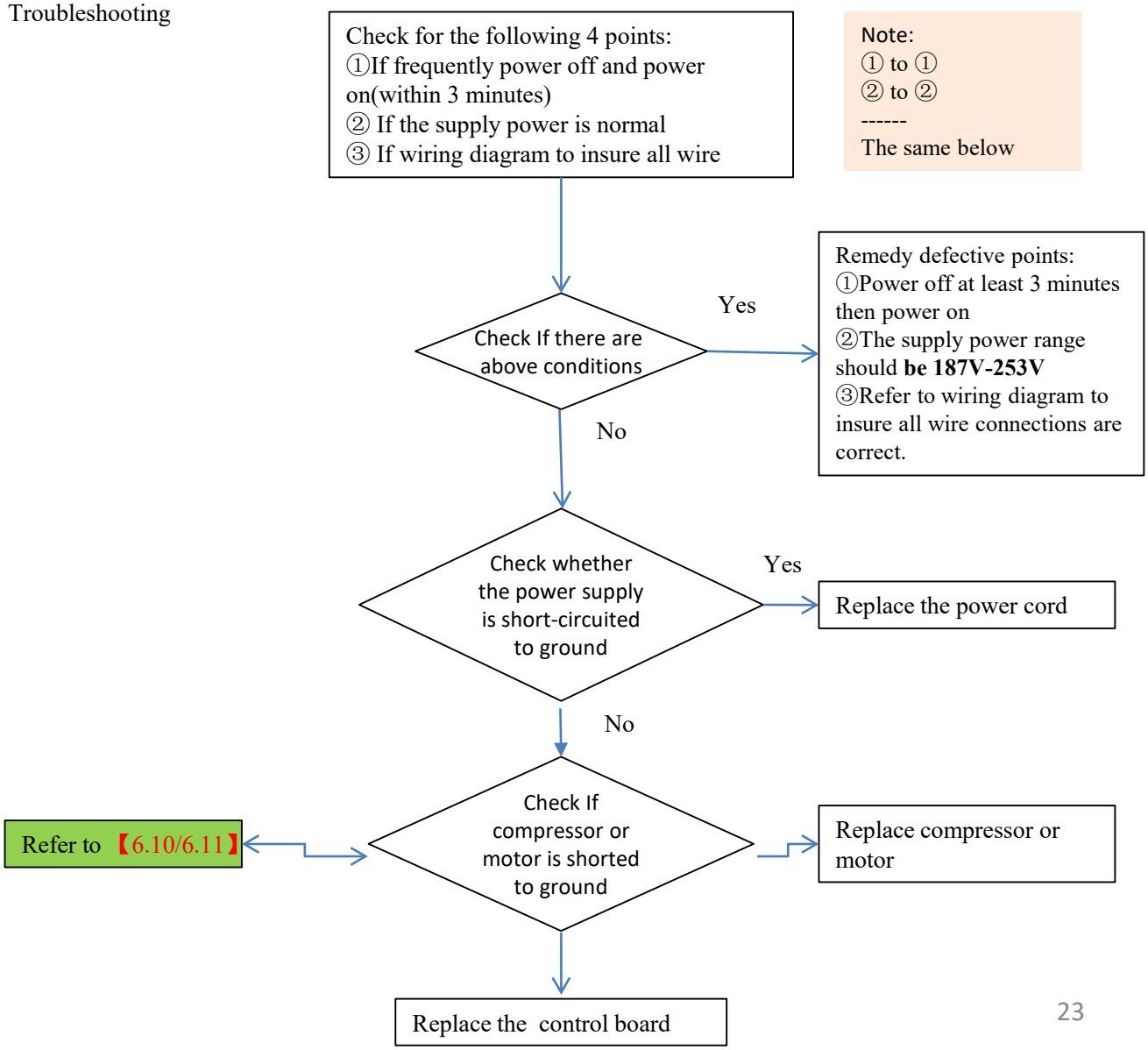
1. These fault codes will be displayed on the digital tube until the issue is resolved.

5.2 Symptom-based Troubleshooting

5.2.1 LED OFF

Issue	LED OFF
Model	All
Fault name	/
Classify	Power/electric issue
Possible cause	• Frequently power off and power on （within 3 minutes） • Abnormal power input • Abnormal wire connections
Notes:	

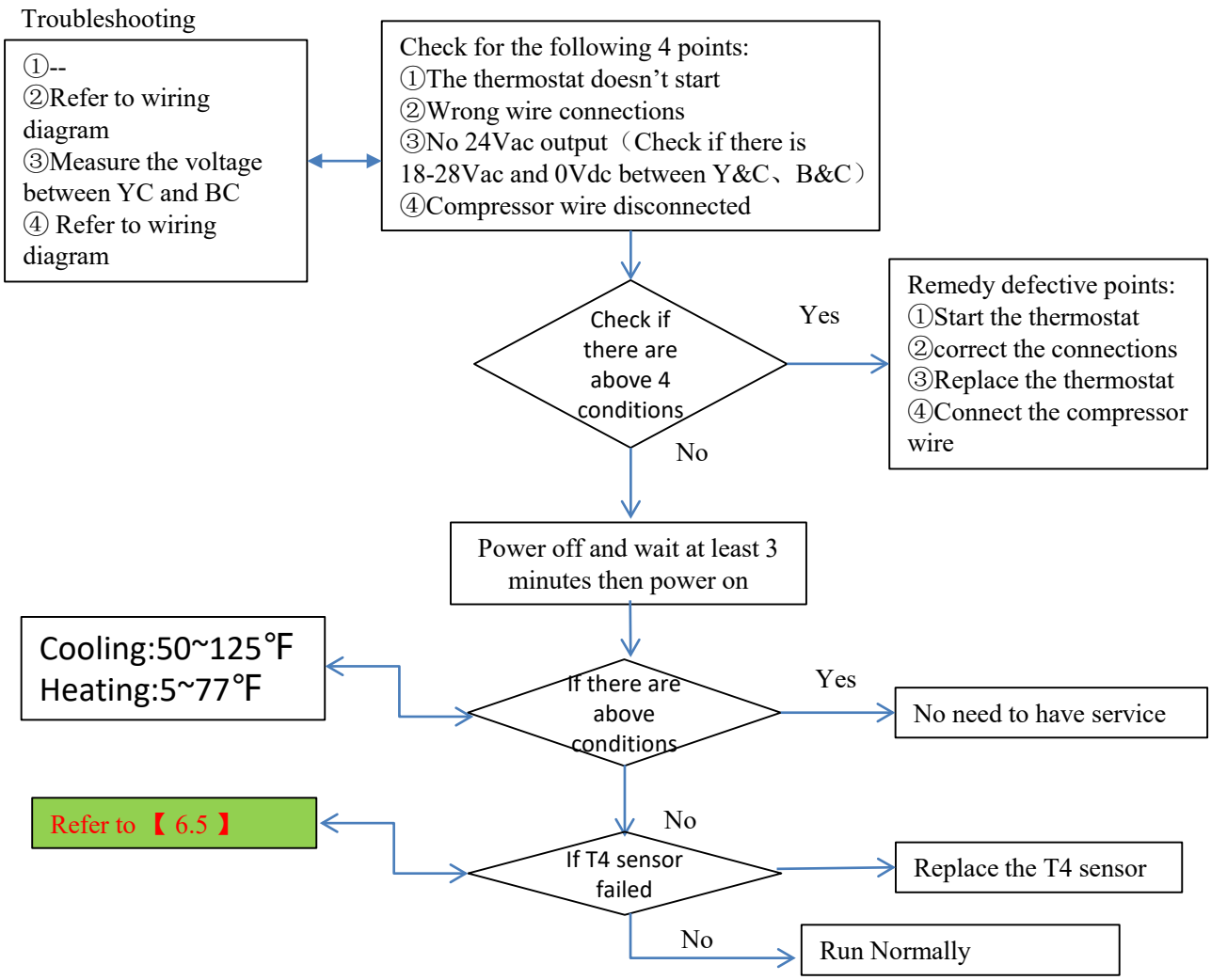
Troubleshooting



5.2 Symptom-based Troubleshooting

5.2.2 System does not start operation

Issue	System does not start operation
Model	All
Fault name	/
Classify	Thermostat fault
Possible cause	• The thermostat doesn't start • Wrong wire connections between thermostat and unit • Damaged thermostat • Disconnect the compressor wire（could be caused after service）
Notes:	

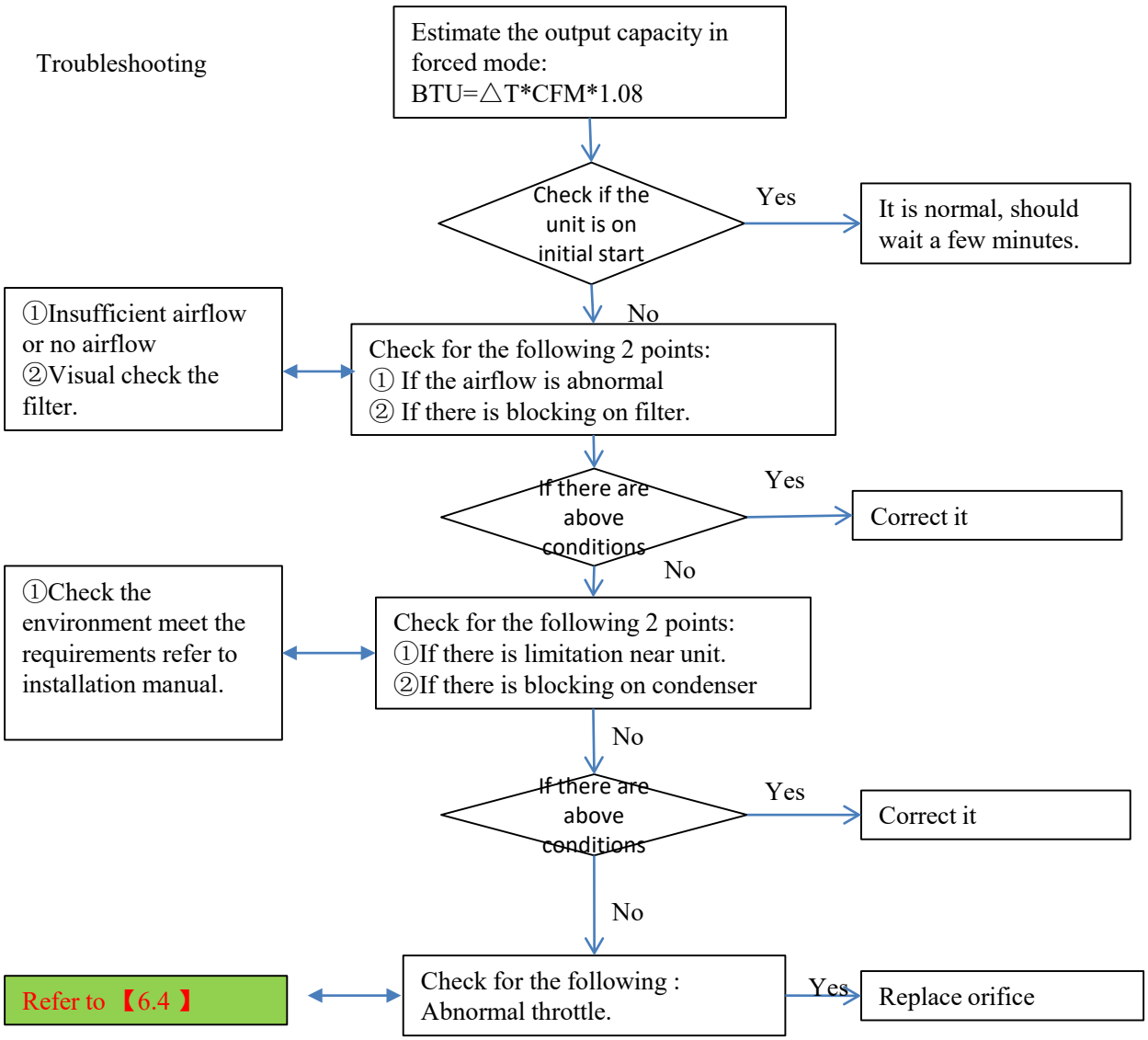


5.2 Symptom-based Troubleshooting

5.2.3 Capacity is low

Issue	Capacity is low
Model	All
Name	/
Classify	System fault
Possible cause	• Poor heat dissipation of the evaporator • Poor heat dissipation of the condenser • Under charged • First start

Troubleshooting

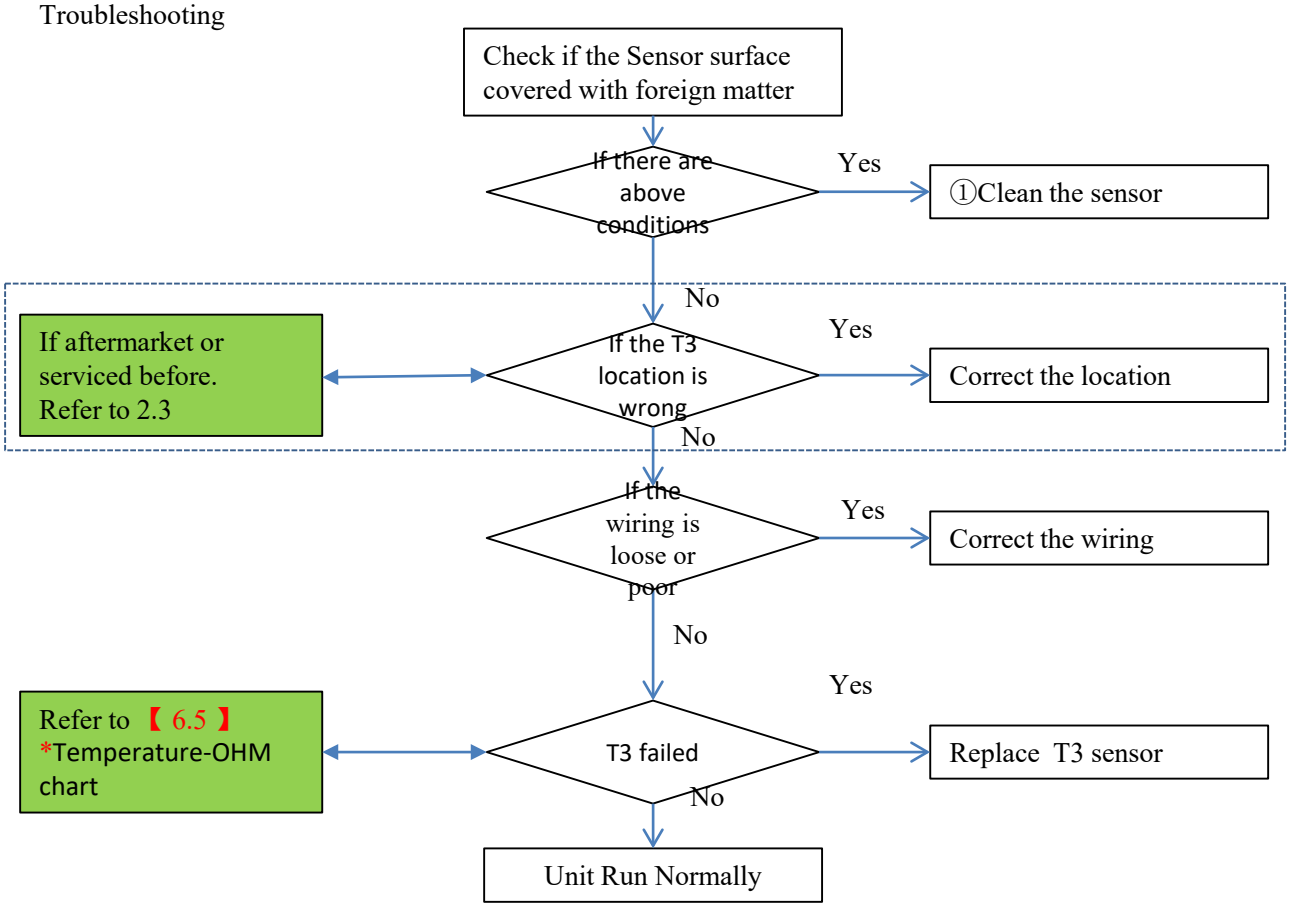


5.3 Troubleshooting by Main board Fault code

5.3.1 LED-1 Flash/cycle

Faulty code	LED-1 Flash/cycle
Model	All
Name	T3 sensor not reading correctly in cooling
Classify	System fault
Possible cause	• **Wrong location of T3 sensor** • Faulty T3 sensor • The wiring terminal is loose or poor • The Sensor surface covered with foreign matter

Troubleshooting

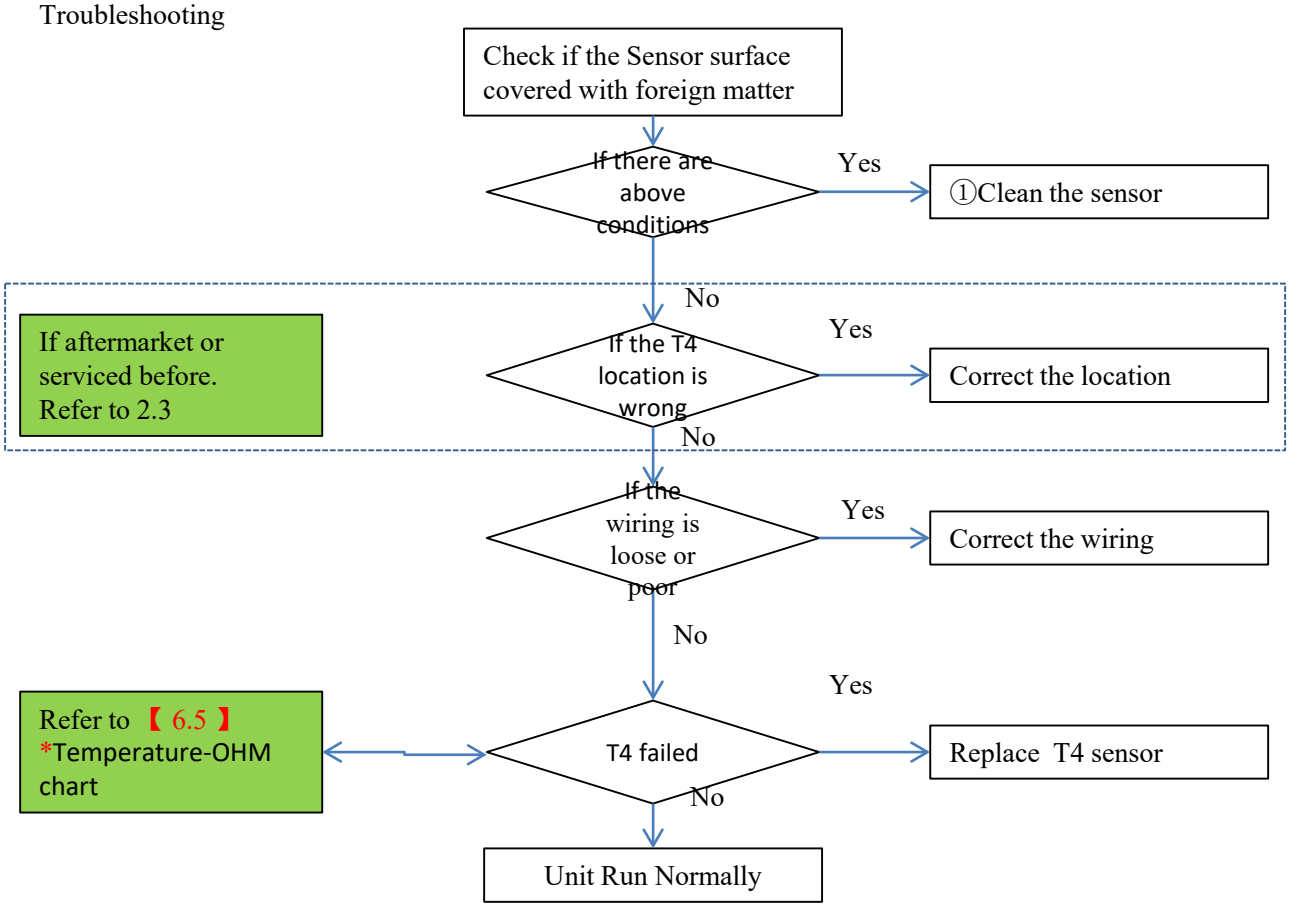


5.3 Troubleshooting by Main board Fault code

5.3.2 LED-2 Flash/cycle

Faulty code	LED-2 Flash/cycle
Model	All
Name	T4 sensor not reading correctly in cooling
Classify	System fault
Possible cause	• **Wrong location of T4 sensor** • Faulty T4 sensor • The wiring terminal is loose or poor • The Sensor surface covered with foreign matter

Troubleshooting



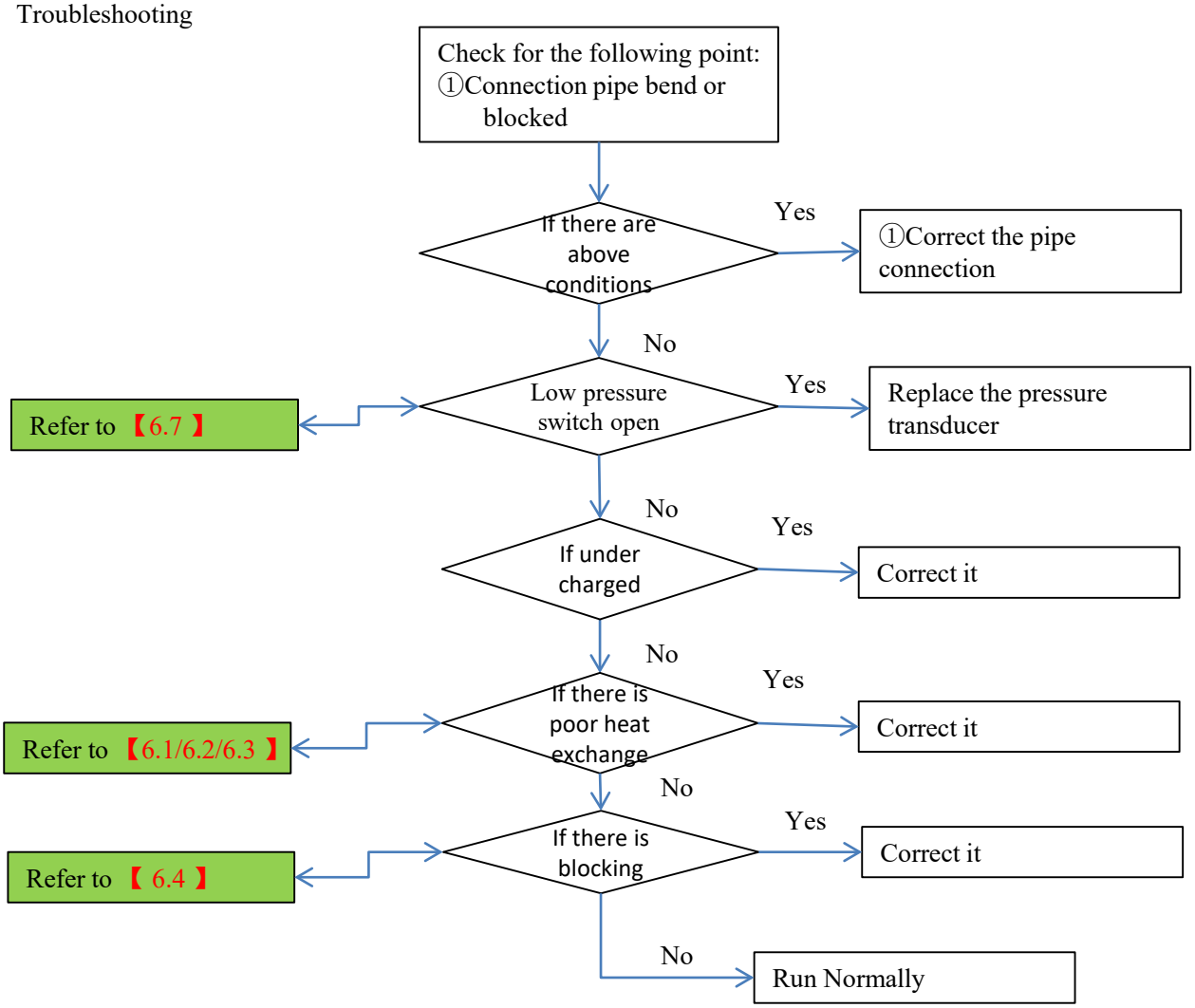
TUTOKOOL the best for less

5.3 Troubleshooting by Main board Fault code

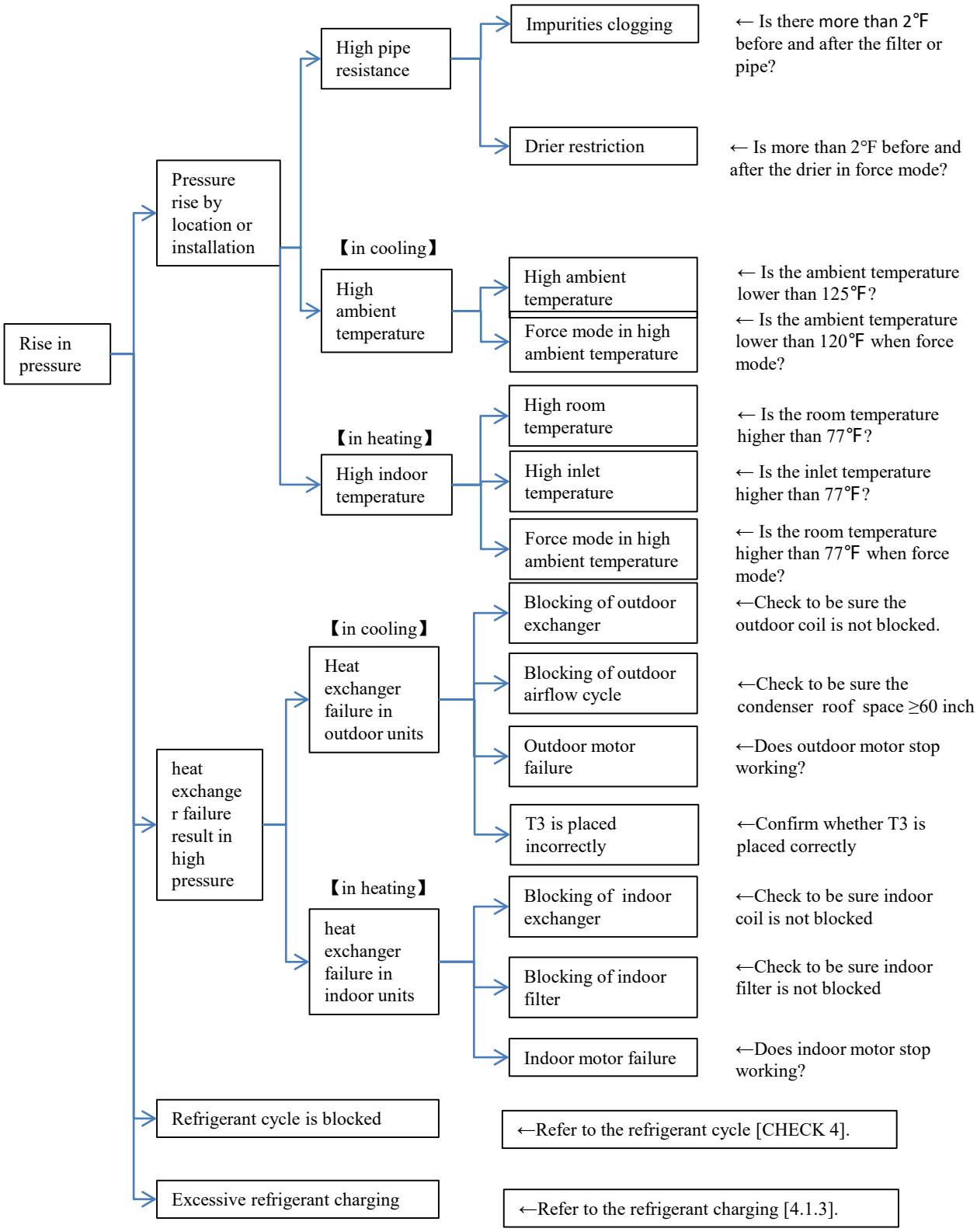
5.3.3 LED-3 Flash/cycle

Faulty code	LED-3 Flash/cycle
Mode	All
Name	Low pressure protection
Classify	System fault
Possible cause	• Indoor fan stopped abnormally / poor heat exchange • **orifice/filter drier/indoor coil blocked** • Under charged

Troubleshooting

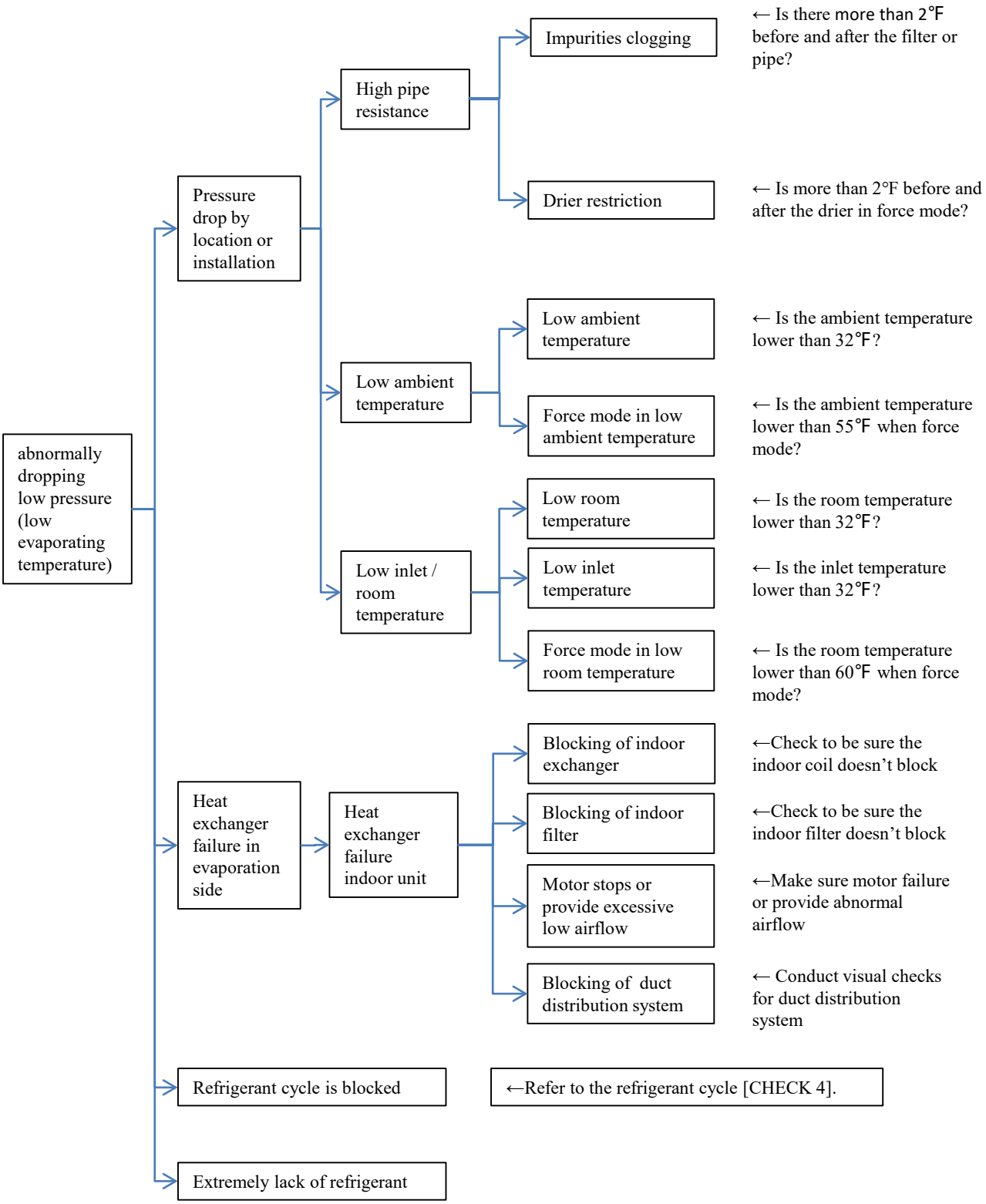


CHECK 1 6.1 Check for Causes of Rise in High Pressure

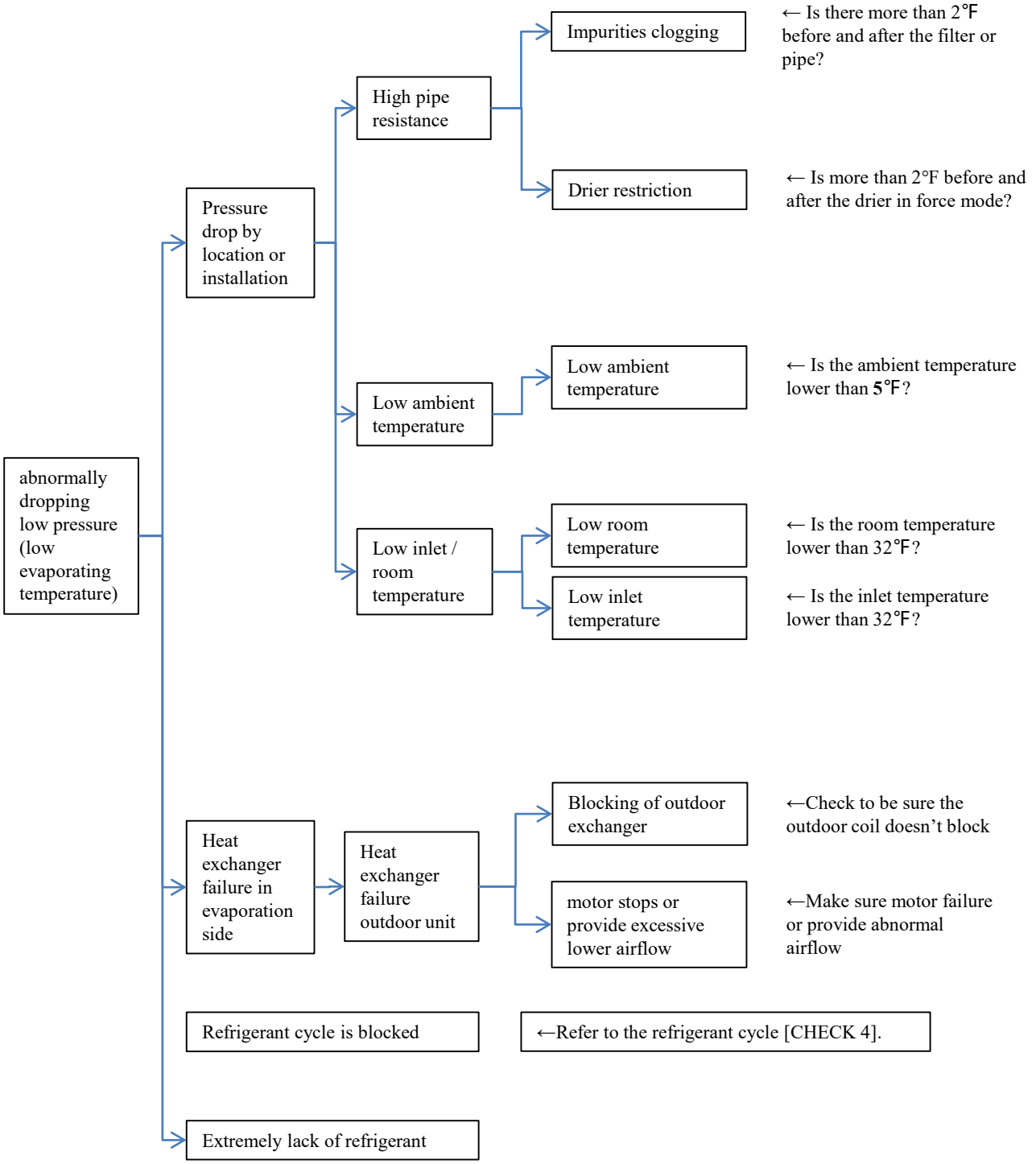


CHECK 2 6.2 Check for Causes of Dropping Low Pressure in cooling

Note: 110-140PSIG head pressure is normal in cooling conditions. The value may be lower/higher at maximum/minimum/limited frequency of compressor operation . Start-up or return oil stages.

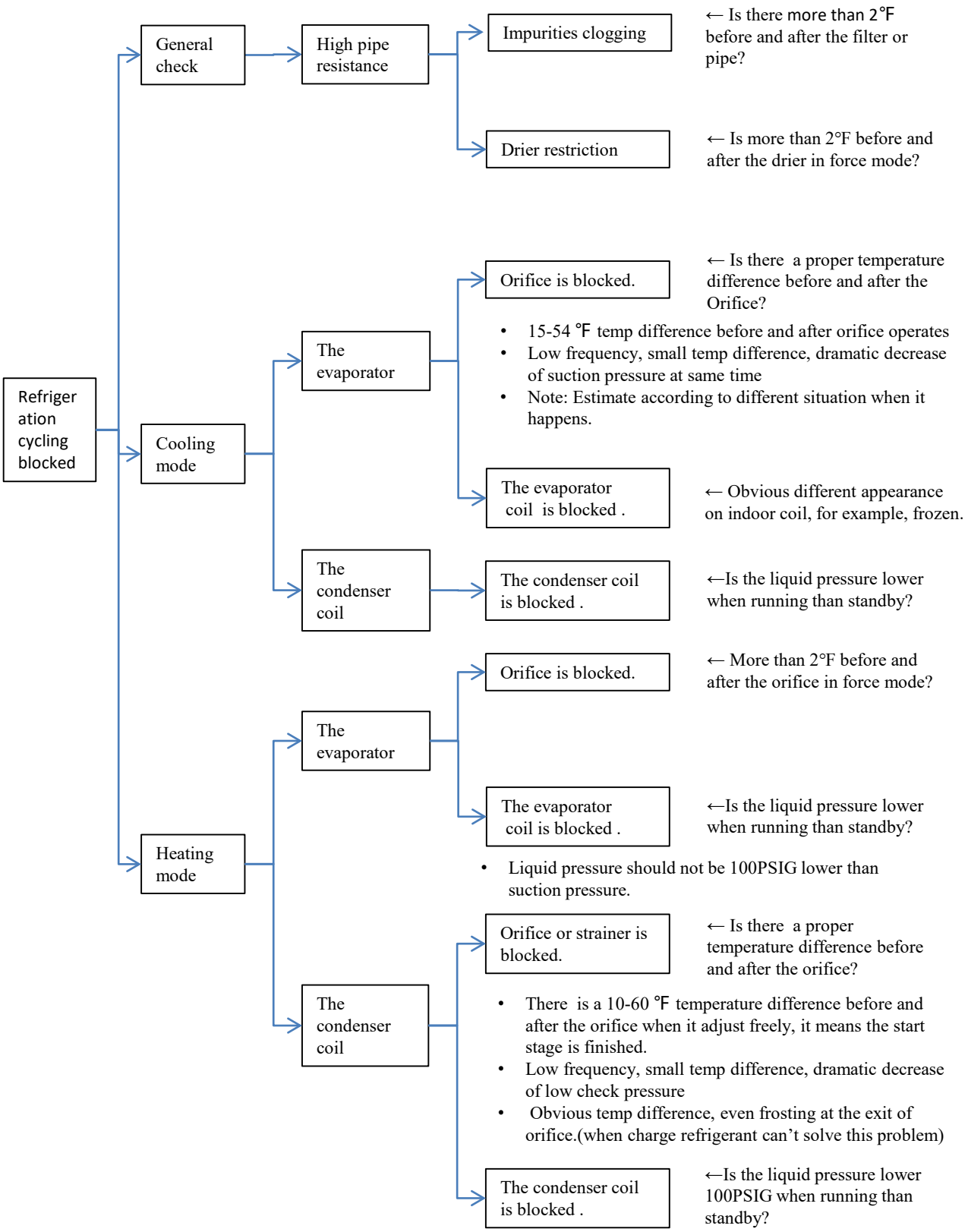


CHECK 3 6.3 Check for Causes of Dropping Low Pressure in heating



CHECK 4 6.4 Check for Causes of Refrigeration cycling blocked

Note: Check at normal and force mode operation, some problems will be more obvious.



CHECK 5 6.5 Check for Temperature Sensor（T3/T4）

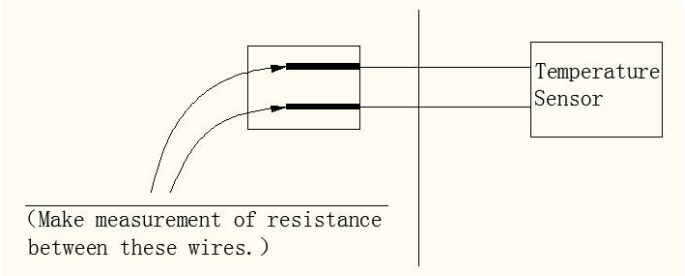
Check temp transducer（T3/T4）：
Compare the temperature checked (T3-3#/T4-4#/T5-5#, refer to 4.1.5), it's normal if the temperature difference was within 15℉ when standby.(need to avoid the waste heat affect T5/Tf when standby mode)

T3/T4: 77 ℉ --10KΩ

Normal
Yes → Work well
No

Ambient temp below -4℉?
Yes → Out of operating range. Do nothing
No

When power off and sensor unplugged



Resistance in thermistor meet the chart above?
No → Replace sensor
Yes

点检参数与左表是否一致?
No → Replace the control board

Note：low probability, caution in handling

Refer to 【Appendix 2】

Yes → Work normal

CHECK 6 6.6 Check for High Pressure Switch（HPS）

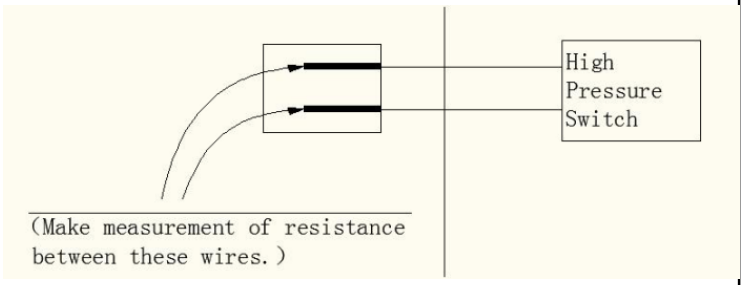
High Pressure Switch：
Whether the switch can start normally when start the machine

Start normally

Yes → Work well

No

When power off and pull up



High pressure switch secure, no wiring damages?

No → Reconnect/fix the wiring damages

Yes

R < 1Ω

No → abnormal pressure switch, replace it

Yes

Still in high pressure protection?

Yes → Should replace board

Note: low probability, caution in handling

No → Work well

Note:
Normal high pressure switch opens above 600PSIG, resets below 435PSIG.

CHECK 7 6.7 Check for Low Pressure Switch（LPS）

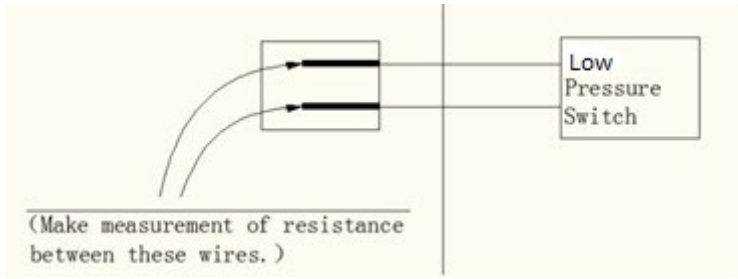
High Pressure Switch：
Whether the switch can start normally when start the machine

Start normally

Yes → Work well

No

When power off and pull up



High pressure switch secure, no wiring damages?

No → Reconnect/fix the wiring damages

Yes

R < 1Ω

No → abnormal pressure switch, replace it

Yes

Still in high pressure protection?

Yes → Should replace board

Note: low probability, caution in handling

No → Work well

Note:
Normal high pressure switch opens below 21PSIG, resets above 44PSIG.

CHECK 8 6.8 Check for Discharge Temperature Switch（T5）

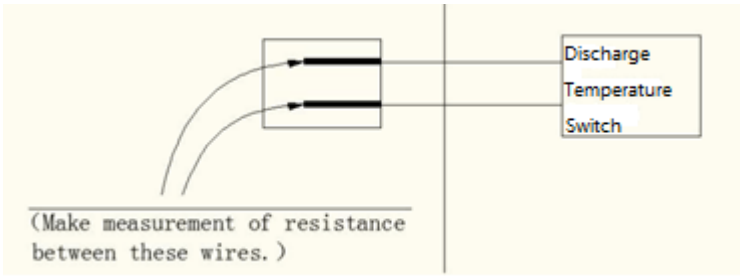
Discharge Temperature Switch：
Whether the switch can start normally when start the machine

Start normally

Yes → Work well

No

When power off and pull up



High pressure switch secure, no wiring damages?

No → Reconnect/fix the wiring damages

Yes

R < 1Ω

No → abnormal pressure switch, replace it

Yes

Still in high pressure protection?

Yes → Should replace board

Note: low probability, caution in handling

No → Work well

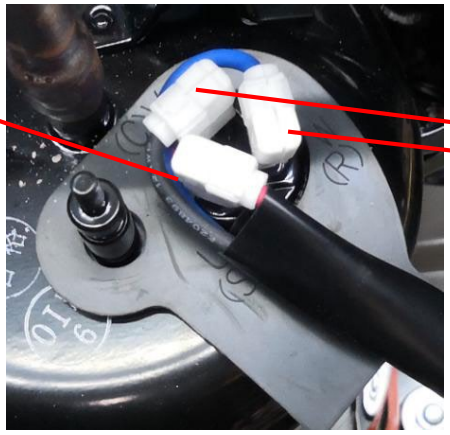
Note:
Normal discharge temperature switch opens above 239℉, resets below 167℉.

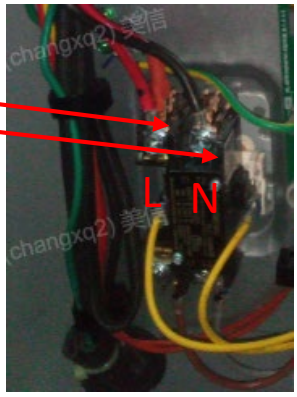
CHECK 9 6.9 Check for Compressor

Compressor：
Whether compressor can start normally

Normal? — Yes → Work well

No → When power off，after 3minutes and unplugged





For Scroll compressor, supply wring is unitary, you can check it with colour (Red for L1, Black for L2, White for S)

Resistance （Ω）	Rotary	Scroll
Between R and C （ L1 and L2 ）	<2	<2
Between C and S (L1 and S)	<2	<1
Between R and S (L2 and S)	<4	<1
Between U/V/W and ground	>10M	>10M

Normal compressor winding? — No → Compressor replace

Yes → If the ground resistance is normal? — No → Compressor replace

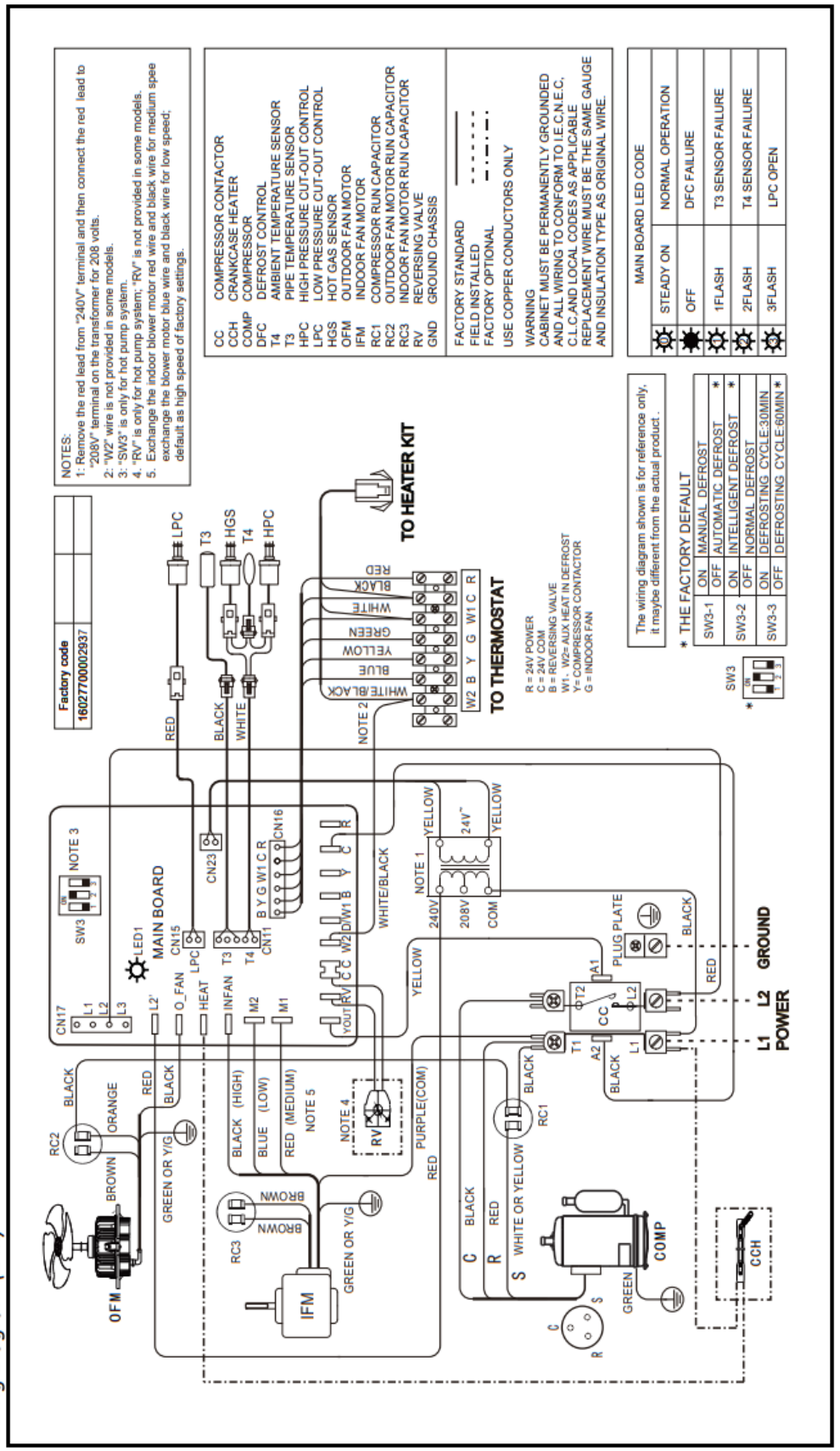
Yes → If the compressor current is normal — No → Compressor replace

Yes → Check according to the condition of whole unit

PART 7 Appendix

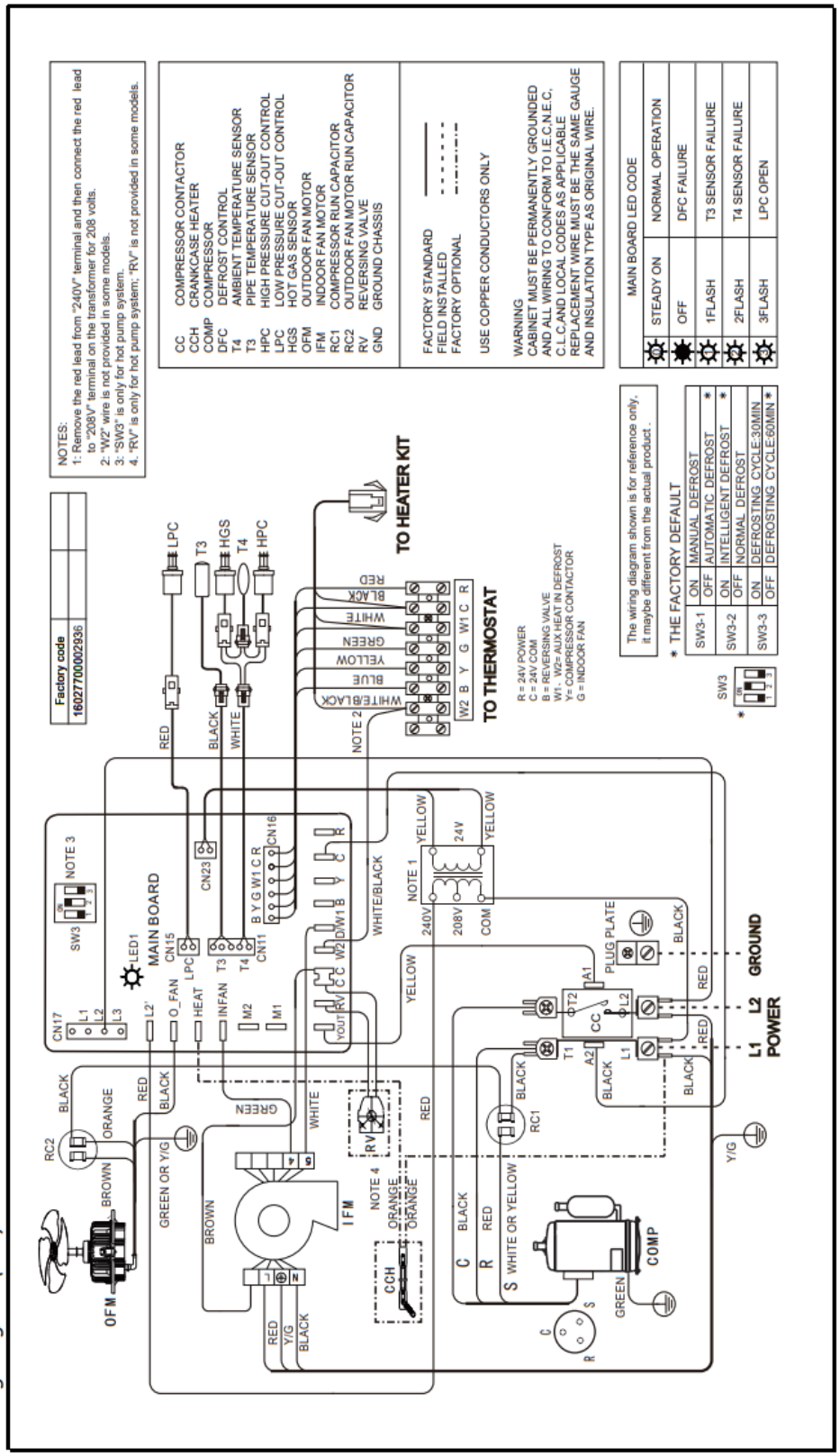
Appendix 1 7.1 Wiring diagrams for 24K

Wiring Diagram-(24k)

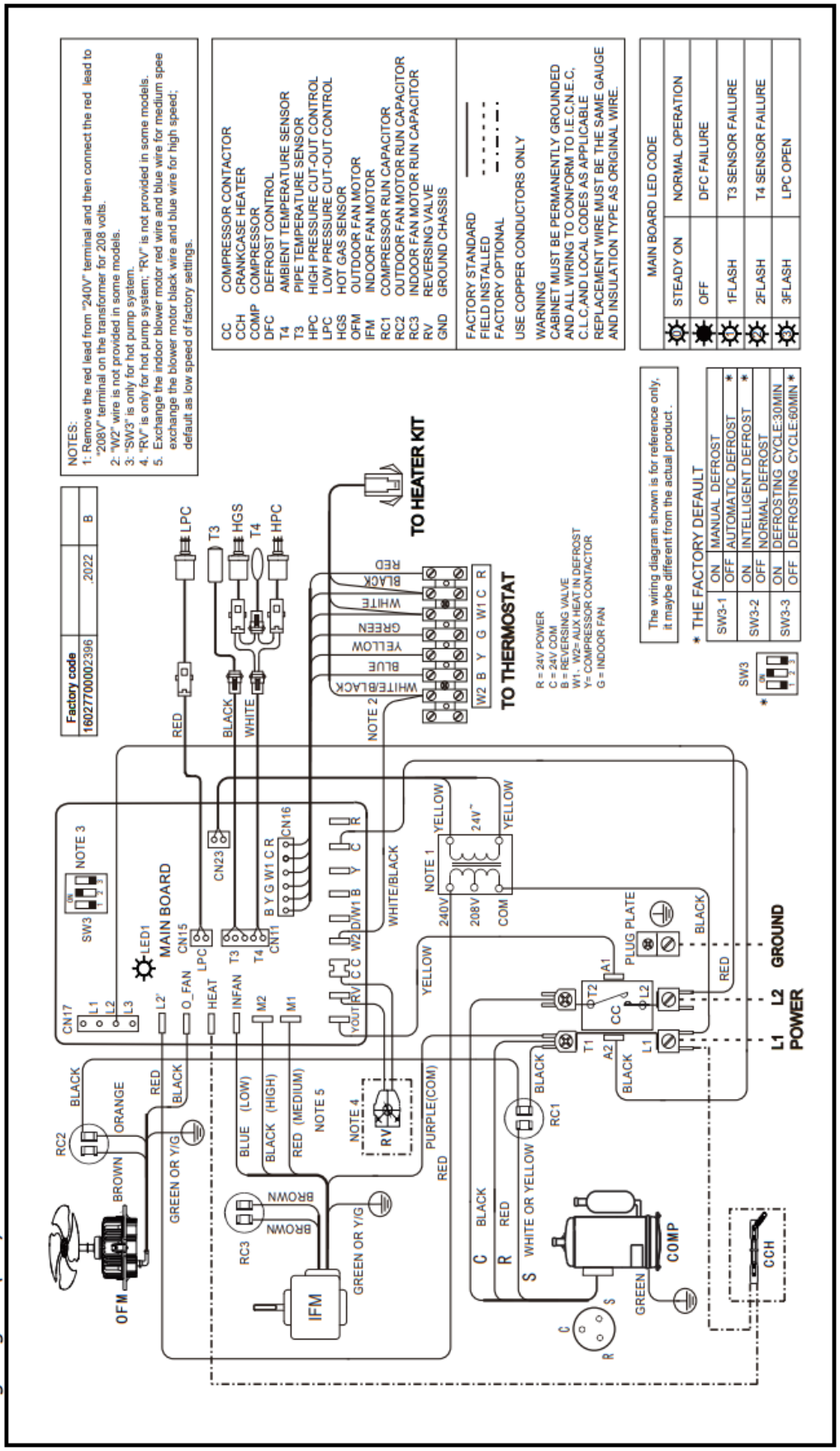


Appendix 1 7.1 Wiring diagrams for 36K

Wiring Diagram-(36k)



Appendix 1 7.1 Wiring diagrams for 48K



Wiring Diagram-(48k)

Appendix 1 7.1 Wiring diagrams for 60K

Wiring Diagram-(60K)

Appendix 2 7.2 Temperature and Resistance Relationship Tables

Temperature °F	Resistance kΩ	Temperature °F	Resistance kΩ	Temperature °F	Resistance kΩ	Temperature °F	Resistance kΩ
-4	106.73	37	29.87	78	10	119	3.69
-3	103.25	38	29.22	79	9.5	120	3.61
-2	99.89	39	28.19	80	9.26	121	3.53
-1	96.65	40	27.39	81	9.03	122	3.45
0	93.53	41	26.61	82	8.81	123	3.38
1	90.53	42	25.85	83	8.59	124	3.3
2	87.62	43	25.12	84	8.38	125	3.23
3	84.83	44	24.42	85	8.17	126	3.16
4	82.13	45	23.73	86	7.97	127	3.1
5	79.52	46	23.07	87	7.78	128	3.03
6	77.01	47	22.42	88	7.59	129	2.96
7	74.58	48	21.8	89	7.4	130	2.9
8	72.24	49	21.2	90	7.22	131	2.84
9	69.98	50	20.61	91	7.05	132	2.78
10	67.8	51	20.04	92	6.88	133	2.72
11	65.69	52	19.49	93	6.72	134	2.67
12	63.65	53	18.96	94	6.56	135	2.61
13	61.68	54	18.44	95	6.4	136	2.56
14	59.78	55	17.94	96	6.25	137	2.5
15	57.95	56	17.45	97	6.1	138	2.45
16	56.17	57	16.98	98	5.96	139	2.4
17	54.46	58	16.52	99	5.82	140	2.35
18	52.8	59	16.08	100	5.68	141	2.3
19	51.2	60	15.65	101	5.55	142	2.25
20	49.65	61	15.23	102	5.42	143	2.21
21	48.16	62	14.83	103	5.3	144	2.16
22	46.71	63	14.43	104	5.18	145	2.12
23	45.31	64	14.05	105	5.06	146	2.08
24	43.95	65	13.68	106	4.94	147	2.03
25	42.64	66	13.32	107	4.83	148	1.99
26	41.38	67	12.97	108	4.72	149	1.95
27	40.15	68	12.64	109	4.61	150	1.91
28	38.97	69	12.31	110	4.51	151	1.88
29	37.82	70	11.99	111	4.41	152	1.84
30	36.71	71	11.68	112	4.31	153	1.8
31	35.64	72	11.38	113	4.21	154	1.77
32	34.6	73	11.09	114	4.12	155	1.73
33	33.59	74	10.8	115	4.03	156	1.7
34	32.61	75	10.53	116	3.94	157	1.66
35	31.67	76	10	117	3.85	158	1.63
36	30.76	77	10	118	3.77	159	1.6

C-cooling H-Heating P-Primary Causes S-Secondary Causes
Comp.-compressor RES.-Restrictions REF.-Refrigeration DEF.-Defective CIR.-Circuit EEV-Electronic expansion valve REV.-Reversing Valve PT-Pressure Transducer T3-Outdoor coil temp. sensor T4-Ambient temp. sensor T5-Comp. discharge temp. sensor Tf-Module radiator fin temp. sensor HPS-High pressure switch
RES I.D. AIRFLOW -Perhaps failue of fan motor or fan capacitor or filter
RES O.D. AIRFLOW -Perhaps failue of fan motor or fan capacitor or recirculation or blocking coil
RES O.D. RADIATOR-Perhaps failue of blocking radiator