HABEGGER
COMPLETE HVAC SOLUTIONS

Ductless 201

presented by:

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EXPERIENCE THE LEGACY. FOCUSED ON THE FUTURE.

Your Habegger Technical Support Team

Commercial Support

- **Dirk Nauman 309-690-9705**
- **Jason Ruggles 309-690-9714**

Residential Support

- **Roman Krywyn 309-690-9711** Peoria, Springfield, Champaign, Spring Valley.
- **Rob Young 309-690-9725** Rock Island, Cedar Rapid IA

Warranty Support

- **Francisco Mendez 309-690-9712**

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List all the parts that may be in a ductless condenser.

1. Reversing valve solenoid
2. Thermistor
3. Inverter
4. Motor
5. Compressor
6. Reactor
7. EEV
8. High/low pressure switch
9. Control Board
10. Base pan heater
11. Compressor sump heater
12. Pressure Transducer
13. …

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You only need to know how to check 3 basic readings

1. AC. Voltage
2. DC Voltage
3. Ohms

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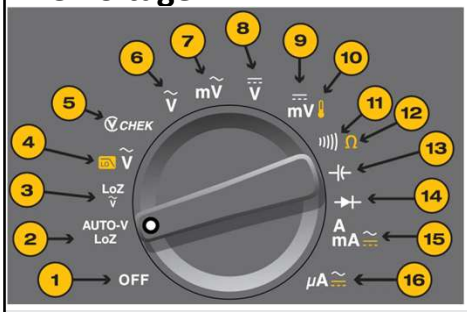
AC Voltage



Write down the number

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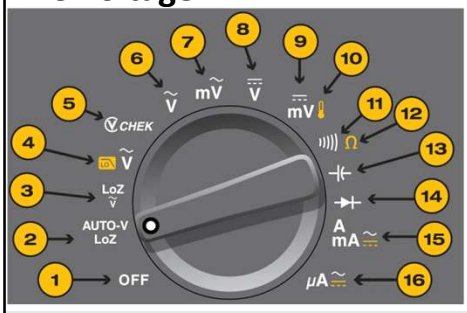
DC Voltage



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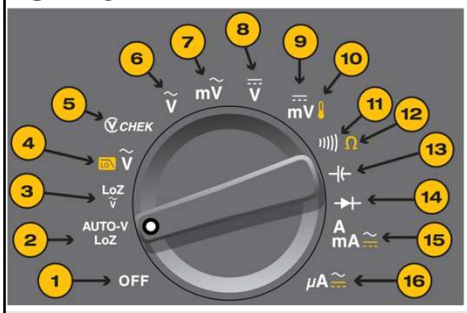
Ohms



Write down the number

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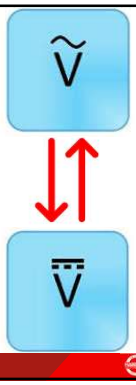
Know Thy Meter



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Thermistor

What does it do?

Only two kinds 10k or 55K

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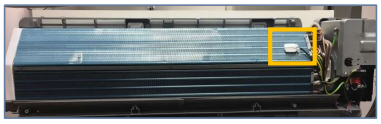
Thermistor/Temperature sensors

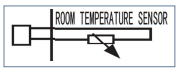
- Room temp. (T1) sensor, **10K**
- Indoor coil temp. (T2) sensor, **10K**
- Outdoor coil temp. (T3) sensor, **10K**
- Outdoor ambient temp. (T4) sensor, **10K**
- **Compressor discharge temp. (T5) sensor. 55K**

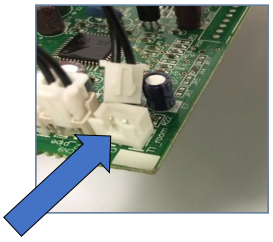
DUCTLESS TECHNOLOGY & PRINCIPLES

RETURN AIR THERMISTOR



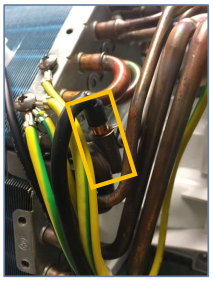
Wire Schematic Label

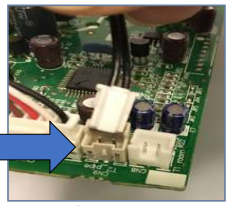




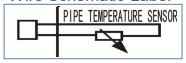
DUCTLESS TECHNOLOGY & PRINCIPLES

EVAPORATOR COIL THERMISTOR



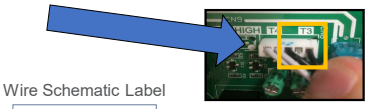


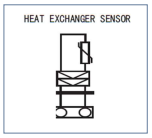
Wire Schematic Label



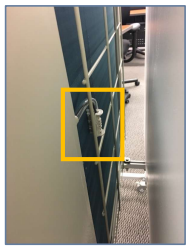
DUCTLESS TECHNOLOGY & PRINCIPLES
CONDENSOR COIL THERMISTOR

Wire Schematic Label

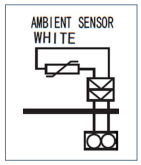


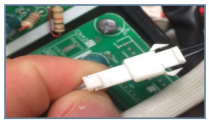


DUCTLESS TECHNOLOGY & PRINCIPLES
OUTDOOR AIR THERMISTOR

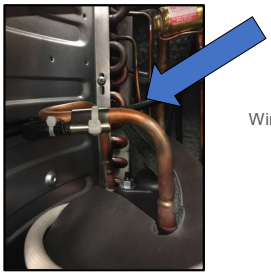


Wire Schematic Label

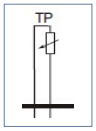


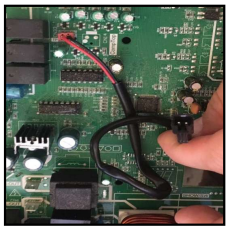


DUCTLESS TECHNOLOGY & PRINCIPLES
DISCHARGE TEMPERATURE THERMISTOR

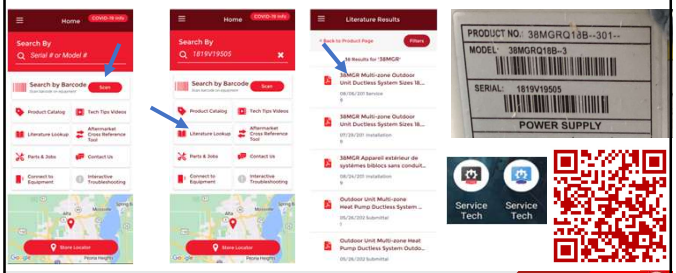


Wire Schematic Label





Find the service manual for this condenser



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10K Thermistor Chart

Temperature Sensor Resistance Value

°C	°F	K OHM	°C	°F	K OHM	°C	°F	K OHM	°C	°F	K OHM
-20	-4	115.266	20	68	12.6431	60	140	2.35774	100	212	0.62973
-19	-2	108.146	21	70	12.0501	61	142	2.27249	101	214	0.61148
-18	0	101.517	22	72	11.5	62	144	2.19073	102	216	0.59386
-17	1	96.3423	23	73	10.9731	63	145	2.11241	103	217	0.57683
-16	3	89.5969	24	75	10.4706	64	147	2.03732	104	219	0.56038
-15	5	84.219	25	77	10	65	149	1.96532	105	221	0.54448
-14	7	79.311	26	79	9.53674	66	151	1.89627	106	223	0.52912
-13	9	74.536	27	81	9.12445	67	153	1.83003	107	225	0.51426
-12	10	70.1898	28	82	8.71983	68	154	1.76647	108	226	0.49989
-11	12	66.0898	29	84	8.33566	69	156	1.70547	109	228	0.486
-10	14	62.2756	30	86	7.97078	70	158	1.64691	110	230	0.47256
-9	16	58.7079	31	88	7.62411	71	160	1.59068	111	232	0.45957
-8	18	56.3694	32	90	7.29464	72	162	1.53668	112	234	0.44699
-7	19	52.2438	33	91	6.98142	73	163	1.48481	113	235	0.43482
-6	21	49.3161	34	93	6.68355	74	165	1.43498	114	237	0.42304
-5	23	46.5725	35	95	6.40021	75	167	1.38703	115	239	0.41164
-4	25	44	36	97	6.13059	76	169	1.34105	116	241	0.4006
-3	27	41.5879	37	99	5.87369	77	171	1.29678	117	243	0.38991
-2	28	39.8239	38	100	5.62961	78	172	1.25423	118	244	0.37956
-1	30	37.7486	39	102	5.39689	79	174	1.2133	119	246	0.36954
0	32	35.7524	40	104	5.17519	80	176	1.17393	120	248	0.35982
1	34	33.8304	41	106	4.96392	81	178	1.13604	121	250	0.35042
2	36	31.9635	42	108	4.76253	82	180	1.09958	122	252	0.3413
3	37	29.9058	43	109	4.5705	83	181	1.06448	123	253	0.33246
4	39	28.3459	44	111	4.38736	84	183	1.03069	124	255	0.3239
5	41	26.8778	45	113	4.21263	85	185	0.99815	125	257	0.31559
6	43	25.4954	46	115	4.04589	86	187	0.96681	126	259	0.30754
7	45	24.1932	47	117	3.88673	87	189	0.93662	127	261	0.29974
8	46	22.9662	48	118	3.73476	88	190	0.90753	128	262	0.29216
9	48	21.8094	49	120	3.58962	89	192	0.8795	129	264	0.28482

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50K Temperature Sensor

Unit C Discharge Temperature Sensor

°C	°F	K OHM	°C	°F	K OHM	°C	°F	K OHM	°C	°F	K OHM
-20	-4	542.7	20	68	85.66	60	140	13.59	100	212	3.702
-19	-2	511.9	21	70	85.66	61	142	13.11	101	214	3.595
-18	0	483	22	72	80.97	62	144	12.65	102	216	3.492
-17	1	455.9	23	73	76.98	63	145	12.21	103	217	3.392
-16	3	430.5	24	75	72.82	64	147	11.79	104	219	3.296
-15	5	406.7	25	77	68.94	65	149	11.38	105	221	3.203
-14	7	384.3	26	79	65.28	66	151	10.99	106	223	3.113
-13	9	363.3	27	81	50.28	67	153	10.61	107	225	3.025
-12	10	343.6	28	82	48.14	68	154	10.25	108	226	2.941
-11	12	325.1	29	84	46.11	69	156	9.902	109	228	2.86
-10	14	307.7	30	86	44.17	70	158	9.569	110	230	2.781
-9	16	291.3	31	88	42.33	71	160	9.248	111	232	2.704
-8	18	275.9	32	90	40.57	72	162	8.94	112	234	2.63
-7	19	261.4	33	91	38.89	73	163	8.643	113	235	2.559
-6	21	247.8	34	93	37.3	74	165	8.358	114	237	2.489
-5	23	234.9	35	95	35.78	75	167	8.084	115	239	2.422
-4	25	222.8	36	97	34.32	76	169	7.82	116	241	2.357
-3	27	211.4	37	99	32.94	77	171	7.566	117	243	2.294
-2	28	200.7	38	100	31.62	78	172	7.321	118	244	2.233
-1	30	190.5	39	102	30.36	79	174	7.086	119	246	2.174
0	32	180.9	40	104	29.15	80	176	6.859	120	248	2.117
1	34	171.7	41	106	28	81	178	6.641	121	250	2.061
2	36	163.3	42	108	26.9	82	180	6.43	122	252	2.007
3	37	155.2	43	109	25.86	83	181	6.226	123	253	1.955
4	39	147.6	44	111	24.85	84	183	6.033	124	255	1.905
5	41	140.4	45	113	23.89	85	185	5.844	125	257	1.856
6	43	133.5	46	115	22.89	86	187	5.663	126	259	1.808
7	45	127.1	47	117	22.1	87	189	5.488	127	261	1.762
8	46	121	48	118	21.26	88	190	5.32	128	262	1.717
9	48	115.2	49	120	20.46	89	192	5.157	129	264	1.674
10	50	109.8	50	122	19.69	90	194	5	130	266	1.632
11	52	104.6	51	124	18.96	91	196	4.849			
12	54	99.69	52	126	18.26	92	198	4.703			
13	55	95.05	53	127	17.58	93	199	4.562			
14	57	90.66	54	129	16.94	94	201	4.426			
15	59	86.49	55	131	16.32	95	203	4.294			
16	61	82.54	56	133	15.73	96	205	4.167			

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Yes or **No**, do you own this tool?

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Thermistor Test Procedure

Thermistor Sensor

1. Remove wiring harness of thermistor from board
2. Measure temperature that thermistor was reading with a temp probe
3. Compare the measurements to the chart in the service manual (it is usual for the thermistor may be off a few degrees)
4. Check each wire going to the thermistor to chassis ground (should be OL or mega ohm reading)

Control Board Thermistor Circuit

1. With harness still unplugged from control board , verify 5vdc on the two pins the thermistor was connected to.
    1. A. If 5 vdc is present then control board passes
    2. B. If there is no voltage or abnormal voltage +/- 10% then the control board fails

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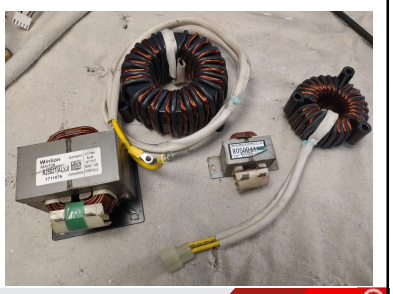
Reactor



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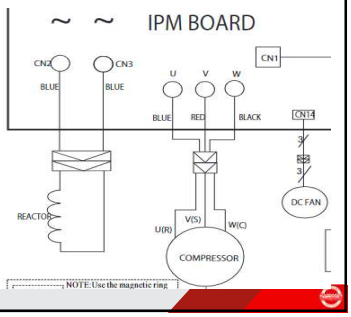
Reactor

What does it do?

Answer: Cleans up the power Supply.

When in doubt check it out.

The normal values should be around zero ohm. Otherwise, the reactor has a malfunction and must be replaced.



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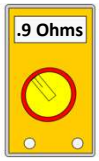
Reactor Test Procedure

1. Perform static Ohms test and record the number (Ohm, out your meter leads by touching them together
2. Get Ohms reading on reactor, unplug from board
   Reactor must read less then 1 Ohm after subtracting stating ohms reading (step 1)
   Less than- 1 Ohm- reactor is good
   More than- 1 Ohm- reactor has failed

Always check reactor to chassis ground



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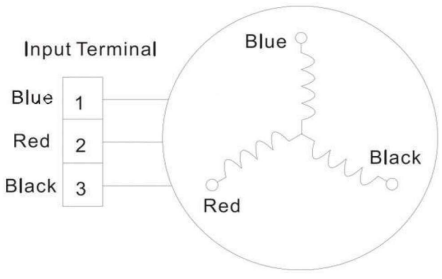
Compressor

Test all terminal to each other



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Compressor

What is the Ohm reading supposed to be ?

Answer: The Same **(10% tolerance-7% is suspect)**

Meter #1
Blue-Red 1.0 Ohms
Blue-Black 1.0 Ohms
Red-Black 1.0 Ohms
Variance of 0.0%
Good or Bad?

Meter #2
Blue-Red 1.04 Ohms
Blue-Black 1.04 Ohms
Red-Black .96 Ohms
Variance of 8.6%
Good or Bad?

Resistance Value	KTF310D43UMT	KTQ420D1UMU	ATN150D30UFZA KTM240D43UKT	EAPQ420D1UMUA
Blue-Red	0.65Ω	0.37Ω	1.03Ω	0.37Ω
Blue-Black				
Red-Black				

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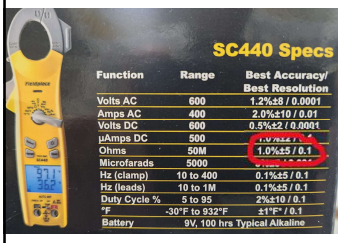
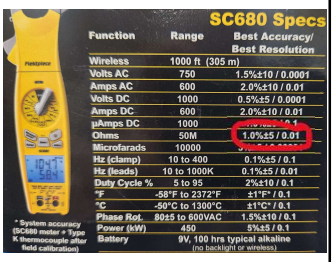


SC440 Specs

Function	Range	Best Accuracy/ Best Resolution
Volts AC	600	1.2%±8 / 0.0001
Amps AC	400	2.0%±10 / 0.01
Volts DC	600	0.5%±2 / 0.0001
µAmps DC	500	1.0%±5 / 0.1
Ohms	50M	
Microfarads	5000	
Hz (clamp)	10 to 400	0.1%±5 / 0.1
Hz (leads)	10 to 1M	0.1%±5 / 0.1
Duty Cycle %	5 to 95	2%±10 / 0.1
°F	-30°F to 932°F	±1°F* / 0.1
Battery	9V, 100 hrs Typical Alkaline	



SC680 Specs

Function	Range	Best Accuracy/ Best Resolution
Wireless	1000 ft (305 m)	
Volts AC	750	1.5%±10 / 0.0001
Amps AC	600	2.0%±10 / 0.01
Volts DC	1000	0.5%±5 / 0.0001
Amps DC	600	2.0%±10 / 0.01
µAmps DC	1000	
Ohms	50M	1.0%±5 / 0.01
Microfarads	10000	
Hz (clamp)	10 to 400	0.1%±5 / 0.1
Hz (leads)	10 to 1000K	0.1%±5 / 0.01
Duty Cycle %	5 to 95	2%±10 / 0.1
°F	-58°F to 2372°F	±1°F* / 0.1
°C	-50°C to 1300°C	±1°C* / 0.1
Phase Rot.	80±5 to 600VAC	1.5%±10 / 0.1
Power (kW)	450	3%±5 / 0.1
Battery	9V, 100 hrs typical alkaline (no backlight or wireless)	

* System accuracy (SC680 meter + Type K thermocouple after field calibration)

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Compressor

Ignore this chart
It is in every manual.
Temperature is a huge factor and that alone makes this chart nearly useless
These numbers are **good ONLY when it is 68 outside and the compressor is new**

Resistance Value	ASM135D23UFZ	ATQ420D1UMU	ASN98D22UFZ	ATF235D22UMT	ATQ360D1UMU
Blue-Red	1.75Ω	0.37Ω	1.57Ω	0.75Ω	0.37Ω
Blue-Black					
Red-Black					

Table 10 — Resistance Value

Resistance Value	ATM115D43UFZ2	ATF250D22UMT KTF250D22UMT	ATF310D43UMT	KSK103D33UEZ3	ASM98D32UFZ
Blue-Red	1.87Ω	0.75Ω	0.65Ω	2.13Ω	2.2Ω
Blue-Black					
Red-Black					

Table 11 — Resistance Value

Resistance Value	ASN140D21UFZ	ASK89D29UEZD	KSN140D21UFZ	KTM240D57UMT	KSN140D58UFZ
Blue-Red	1.28Ω	1.99Ω	1.28Ω	0.62Ω	1.86
Blue-Black					
Red-Black					

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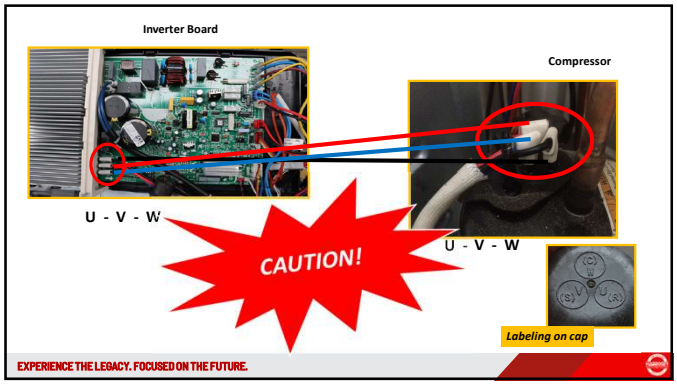

Compressor/Cond Fan Test Procedure

1. **Windings Test**
   - A. Disconnect U V W terminals at control board
   - B. Ohm out U V W terminals to each other and record the reading
     Example- U – V, U – W, W- V
     IF all three readings are within 10% of each other **(7% difference has been observed to cause issues at times)** then the compressor windings are good.
     IF there is a variance of more than 10%,
     -Make sure your meter leads are clean, battery level on meter is good and you are using needle point leads.
     -Perform same test at compressor terminals, **IF** there is a 10% or more variance than the compressor has damaged windings.

ALWAYS check all windings to ground

2. **Mechanical Test "over current" code**
   - A. Refer to manual and do exactly as stated (model specific)
   - B. This is a rare condition (normally caused by non-working crankcase heater)

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Switch- Temperature/Pressure

High Pressure Switch

Low Pressure Switch

Thermal Switch

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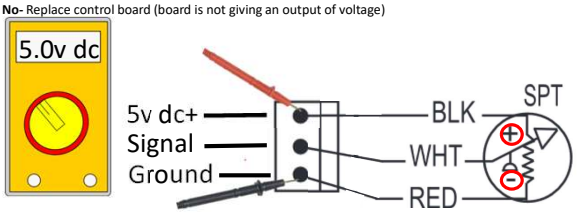
Pressure Transducer

1. *Do you have 5v DC on the power and the ground ?*
   - **Yes-** Go to step 2
   - **No-** Disconnect wiring harness and retest.
     - *Do you have 5v DC on the power and the ground ?*
       - **Yes-** Replace transducer (it is grounded/shorted)
       - **No-** Replace control board (board is not giving an output of voltage)



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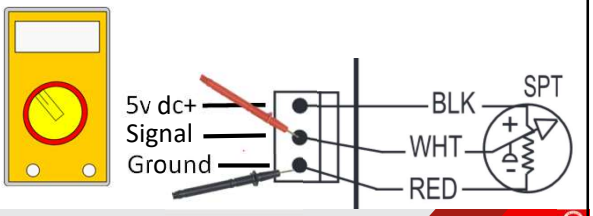
Pressure Transducer

2. Do you have 5v DC on the Signal and the Ground ? (with or without a call)

Never less then .5v DC
Never more then 4.5v DC



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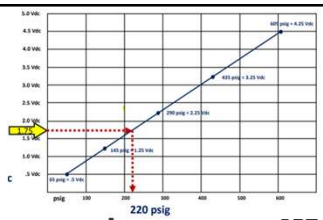
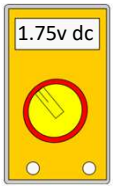
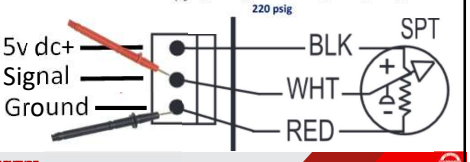
Pressure Transducer

2. Is the transducer reading correctly?

PSIGis reading 220#
How many DC volts should we read?







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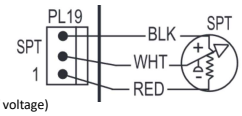
Pressure Transducer Test Procedure

1. *Do you have 5v DC on the power and the ground ?*
   Yes- Go to step 2
   No- Disconnect wiring harness and retest.
   Do you have 5v DC on the power and the ground ?
   Yes- Replace transducer (it is grounded/shorted)
   No- Replace control board (board is not giving an output of voltage)



2. *Do you have 5v DC on the Signal and the Ground ? (with or without a call)*
   Never less then .5v DC
   Never more then 4.5v DC

3. *Is the transducer reading correctly?*
   Low Side PSIG is reading 125#
   How many DC volts should we read?

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EEV – Electronic Expansion Valve

Detachable Coils

Expansion Valves

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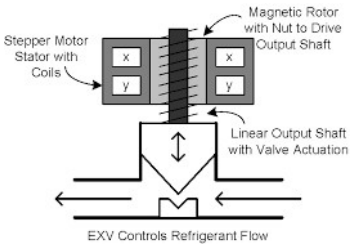
EEV (EXV)

How Does It Work ?



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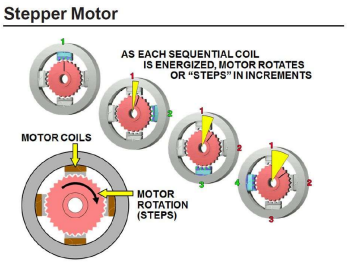
EEV (EXV)

How Does It Work ?

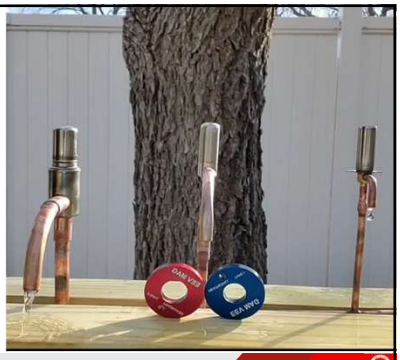


Draw

Two Parts to check:

1. Mechanical

2. Electrical



EEV Test Procedure

1. Ohm out all wires to each other-
   - **5 Wire-** will have only two reading 45 Ohms and 90 Ohms (nominal)
   - **6 Wire-** Will have only three readings 45 Ohms, 90 Ohms (nominal) and OL (open line)
   - **Always-** Check each wire to chassis ground (must be OL or mega ohm reading)
2. Ohm out wires per below chart-
   - **Always-** Check each wire to chassis ground (must be OL or mega ohm reading

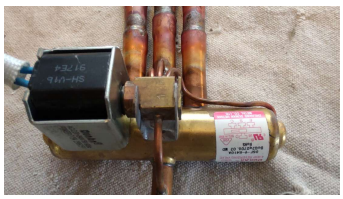
LEAD WINDING COLOR	NORMAL VALUE
Red-Blue	45 Ohms **(nominal)**
Red-Yellow	
Brown-Orange	
Brown-White	

EEV

Reversing Valve

What is its purpose ?

To change the route of refrigerant between the indoor and outdoor coils, which will cause the coils to exchange their functions of condenser and evaporator.



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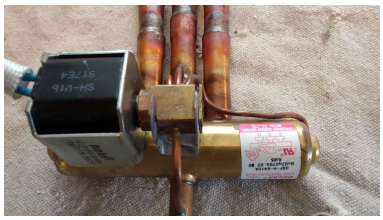
Reversing Valve

BEWARE of **high voltage**



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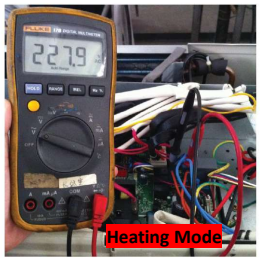
Reversing Valve

Power on. Use a digital tester to measure the voltage. When the unit operates in cooling, it is 0V. When the unit operates in the Heating mode, it is about 230VAC. If the value of the voltage is not in the range, the PCB needs to be replaced.

Air Conditioning Mode



Heating Mode

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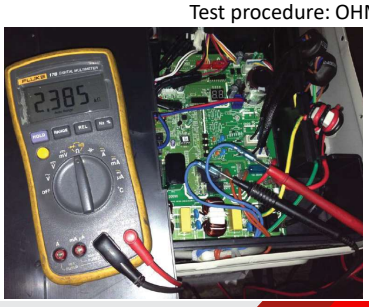
Reversing Valve

Test procedure: OHMS

Resistance of coil should be 1.8-2.5 K Ohms.



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Reversing Valve Test Procedure

AKA 4 way valve

1. Test Reversing Valve Coil

A. Disconnect wire from control board
B. Test Resistance of coil, should be 1.8-2.5 K Ohms
C. Test each wire from coil to valve body for a short. Should read OL

2. Test Supply Voltage

A. **In Cooling** there should be 0 volts
B. **In Heating** there should be the same voltage as supply (L1 and L2)

3. Test Valve Body for Bypass

A. there will be two hot and two cold copper pipes. Measure the two cold pipes (6" + from valve body)
IF the two cold pipes are within 4 degrees of each other the valve body is good
IF the two cold pipes have more than a 4 degree difference than the valve body is bypassing

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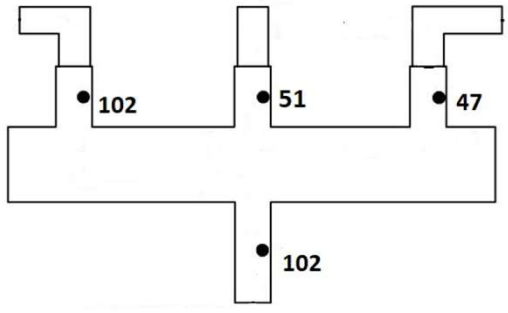

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Compressor Crank Case Heater

What is its purpose?

Crankcase heaters are used to keep the compressor oil at an elevated temperature to ensure the refrigerant does not migrate and mix with the oil.

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Compressor Crankcase Heater Test Procedure

1. Test Crankcase Heater Coil

A. Disconnect wire from control board
B. Test resistance of heater, should be 1.8-2.4 K Ohms
C. Test each wire from heater to chassis for a short (heater needs to be attached to compressor). Should read OL

2. Test Supply Voltage

If ambient is below 38 degrees crankcase heater will have 240 at the control board terminals

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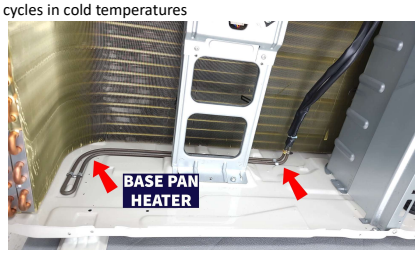
Base Pan Heater

What is its purpose?

Base pan heater used to prevent ice formation and to promote water drainage after defrost cycles in cold temperatures



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Base Pan Heater Test Procedure

1. Test Base Pan Heater Coil

A. Disconnect wire from control board
B. Test resistance of heater, should be 350-450 Ohms (ambient temperature makes a difference).
C. Test each wire from heater to chassis for a short (heater needs to be installed in unit forcorrect reading). Should read OL

2. Test Supply Voltage

System turns on base pan heater before defrost initiation and continues after defrost cycle for an unspecified amount of time (based on thermistor data and algorithm)

Base Pan Heater

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Control Board

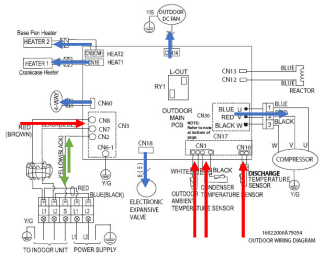

Fig. 8 —Wiring Diagram - Sizes 09K, 12K, 18K (208-230V)

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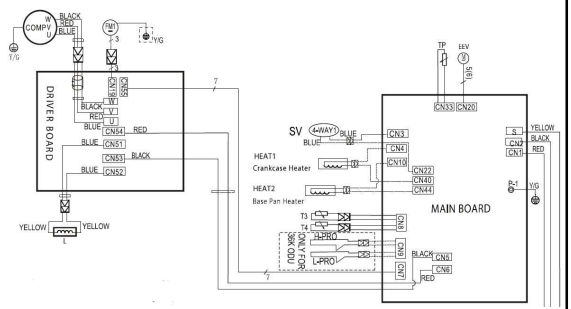
Control Board

Two boards 24K and above



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Control Board

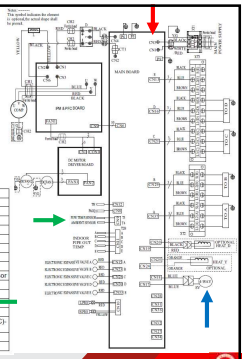

Table 13 — 36K - 4 Zone Max

OUTDOOR UNIT MAIN BOARD	
CODE	PART NAME
CN1~ CN3	Input: 230VAC High voltage
CN13, CN16, CN21, CN29, CN37	Output: Pin1(Connection of the high voltage) "S" Pin2~ Pin3 (230VAC High voltage)"L1&L2"
P5, P6, P9	Connection to the earth
CN22	Output: 24VDC-24VDC
CN17~ CN18	Output: 230VAC High voltage to 4 way valve
CN19~ CN20	Output: 230VAC High voltage Compressor Crankcase Heater
CN24~ CN25	Output: 230VAC High voltage Chassis Crankcase Heater
CN11	Input: Pin1, Pin3, Pin5, Pin7, Pin9 (5VDC) Pin2, Pin4, Pin6, Pin8, Pin10 (0-5VDC) indoor pipe out sensor
CN12	Input: Pin1 (0-5VDC), Pin2 (5VDC) Heatsink Temperature Sensor
CN8	Input: Pin1 (0-5VDC), Pin2 (5VDC) Compressor top sensor (PN03)
CN9	Input: Pin3, Pin4 (5VDC), Pin2 (0VDC), Pin1, Pin5 (0-5VDC) Pipe sensor and ambient sensor
CN15, CN23, CN26 CN30, CN33	Output: Pin1-Pin4: Pulse waveform (0-12VDC), Pin5, Pin6 (12VDC) to EEV
CN6	Communication: Pin1-Pin5: Pulse waveform (0-5VDC), Pin7, Pin9 (0VDC) Pin8 (0-5VDC), Pin10 (5VDC)~to IPM & PFC board
CN2~ CN4	Output: 230VAC High voltage to IPM & PFC Board
CN10	Input: Pin2, Pin4 (0VDC), Pin1, Pin3 (0-5VDC)~HiL Pressure switch

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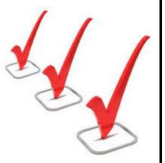
Invertor Board (VFD)

VFD

Three Checks

1. Supply Voltage- AC Voltage
2. Bridge Rectifier- DC Voltage
3. IGBT- Ohms



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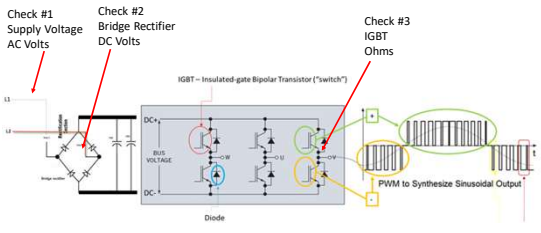

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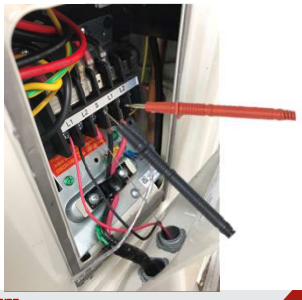
Check #1

Supply Voltage
AC Volts



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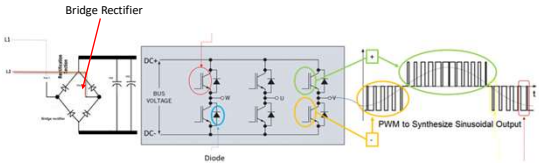
Check#2

Bridge Rectifier- What is it's purpose?



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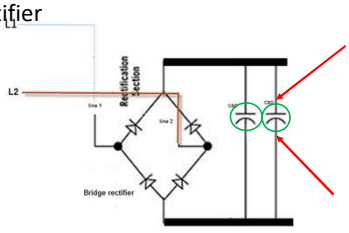
Check#2

Bridge Rectifier



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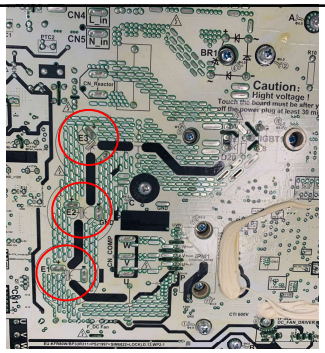
Check #2

Bridge Rectifier
DC Volts



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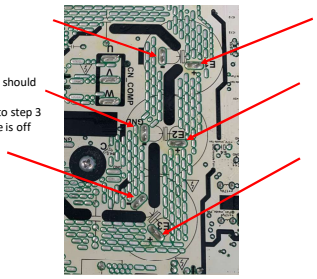
Check #2

Bridge Rectifier

Test Procedure:
1. Power up unit, on stand by
2. Voltage at any one capacitor should be NOMINAL 300V AC.
   1. 300 V N AC present go to step 3
   2. Replace board if voltage is off



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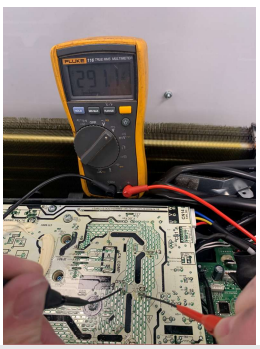

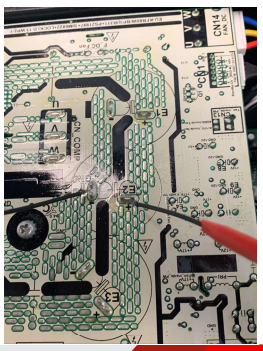

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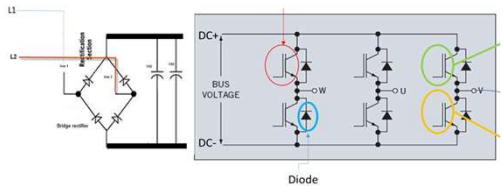
Check #3
IGBT- Insulated Gate Bipolar Transistor



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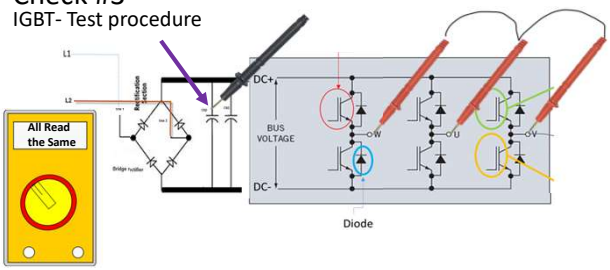
Check #3
IGBT- Test procedure



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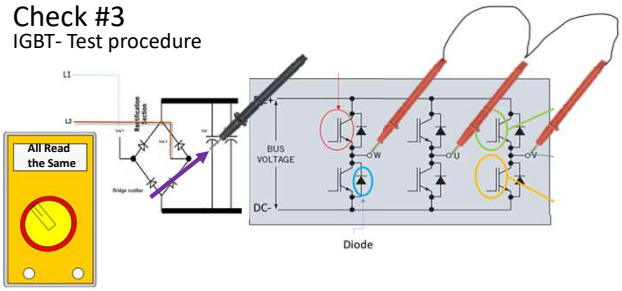
Check #3
IGBT- Test procedure



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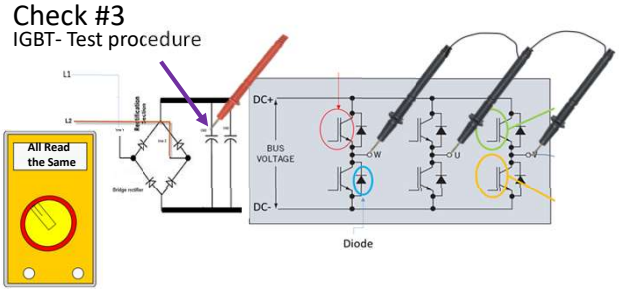
Check #3
IGBT- Test procedure



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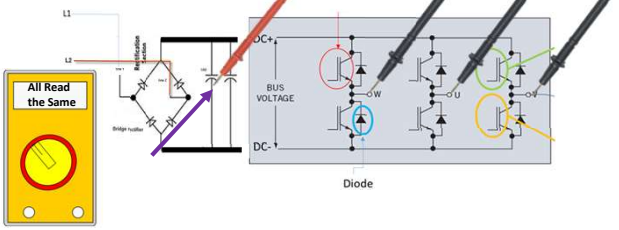
Check #3
IGBT- Test procedure



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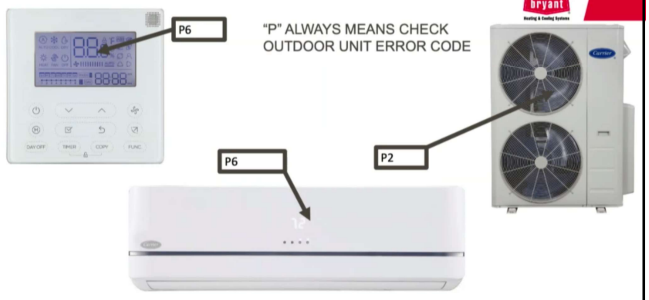
P2



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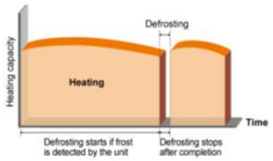
Defrost

According to certain indoor/outdoor ambient temperatures and the pipe temperature of outdoor condenser, defrosting will occur. There is no set time for defrost it is based on the algorithm of the board and the outdoor temperature of the system.



PROPER DELTA T = PROPERLY CHARGED

Turn all heads to max demand (not turbo), wait ten minutes then test for proper temperature split on all indoor units

- Check the TD in **"COOL".** If the TD is between 20-30 degrees, your charge is correct
  (TD= Temp in – Temp out) Temperature Differential

- Check the TD in **"HEAT"** mode.
  If the TD is between 30-40 degrees, your charge is correct. You will see this when temperature is above 30° F.

HABEGGER
COMPLETE HVAC SOLUTIONS

Ductless 201

presented by:
Roman Krywyn
309-690-9711
IL/IA Residential Training & Service Manager

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