CapCheck® II

SUBSTATION TYPE - Model CC-II/100

Capacitor Checker

Operating & Instruction Manual

HD ELECTRIC
HDElectricCompany.com

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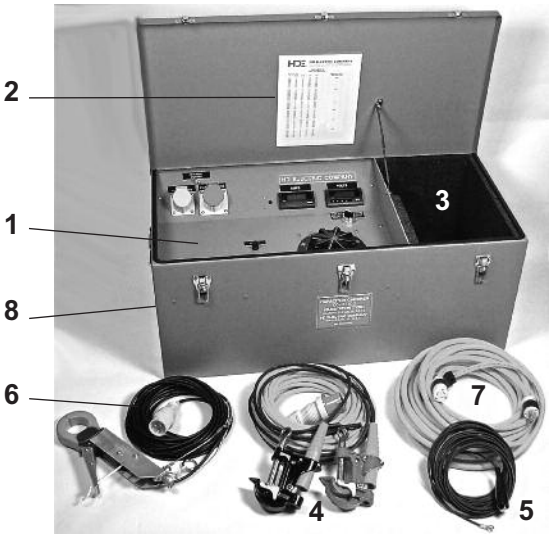
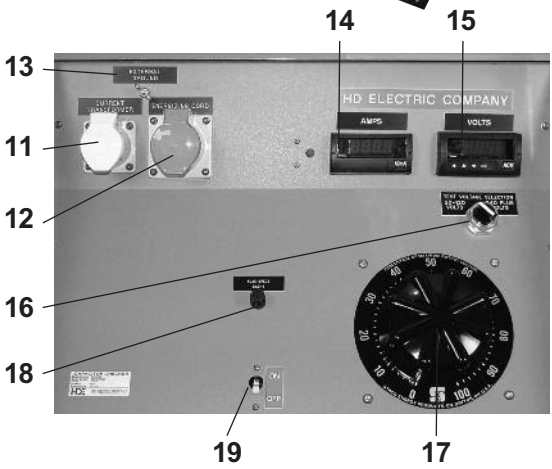
COMPONENT IDENTIFICATION

CAP CHECK II Substation Type MODEL CC-II/100

OPERATING COMPONENTS LAYOUT

1. Instrument Panel
2. Pass / Fail Limit Rating Chart
3. Cordage / Transformer Storage Area
4. Energizing Cord with Clamps
5. Grounding Cable
6. Current Transformer and Cordage
7. Power Cord
8. 110 Volt AC Adapter Cord – 3 prong straight type
9. Hot stick Carrying Bag
10. 4 Section Hot stick
11. Plug for the Current Transformer
12. Polarized plug for the energizing leads
13. Cabinet Ground Stud
14. AC Amps Digital Meter
15. AC Volts Digital Meter
16. Test Voltage Selection Switch
17. Variable Transformer (Variac)
18. Panel Meter Fuse
19. ON/OFF Switch





CAUTION: Make certain capacitors are shorted and de-energized **COMPLETELY** prior to testing. **ALWAYS** be certain capacitor bank to be tested is out of service. Allow at least 5 minutes for capacitors to fully discharge.

CAUTION: Make certain leads **NEVER** cross phases or drape across bushings, live transformers, etc. Cordage must remain free and clear of all objects, including the human body, **AT ALL TIMES.**

CAUTION: Make certain maximum capacitor KVAR and voltage do not exceed the Cap Check II testing limits. Maximum KVAR for the Cap Check II can be noted on the Pass/Fail Limit Rating Chart located at the end of the manual.

CAUTION: Make certain the Cap Check II voltage (Variac) is set to zero (0) prior to turning the instrument on and energizing capacitors.

CAUTION: Always turn the Variac to zero after testing capacitors and before turning the Cap Check II off. This action will discharge the capacitor.

NOTE: Familiarize yourself with the Cap Check II instrument panel layout as diagrammed on the previous pages, prior to conducting your first test.

ADDITIONAL SAFETY NOTES

Please note that your Company may have additional safety rules and procedures, which should be employed while using this equipment. You must check to make certain that all safety considerations are properly addressed when using this equipment. These are recommended safety rules and are to be used as guidelines in establishing and integrating your own safe procedures.

OPERATING PRINCIPLE

The Cap Check operates by measuring the current flowing through the capacitor under test. The operating convenience of this tester comes from the fact that a bank of paralleled capacitors is energized but currents are measured individually without opening any connections. Of course, the current drawn by the paralleled group must not exceed the capacity of the power supply.

SET UP PROCEDURE

IMPORTANT: THE PROCEDURES DESCRIBED ARE GENERAL AND MUST BE REVIEWED AND MODIFIED AS NECESSARY TO CONFORM TO THE USER'S SAFETY RULES, STANDARDS AND REGULATIONS.

ALWAYS REMEMBER THAT THE DISTRIBUTION EQUIPMENT UNDER TEST OPERATES AT HIGH VOLTAGE. THE CAPACITOR BANKS MUST BE DE-ENERGIZED AND COMPLETELY DISCHARGED BEFORE THE TESTING AT THE RELATIVELY LOW VOLTAGE IS PERFORMED.

Every group of paralleled capacitors must be discharged. If these parallel groups are not equipped with shorting switches this must be accomplished in accordance with the user's standard safe operating procedures.

SET UP AND TESTING

To obtain correct results it is necessary that the Cap Check energizing leads be connected across the single parallel group of capacitors being tested. If shorting switches are installed, these can limit the energized capacitors to those under test. If switches are not available it will be necessary to use jumpers. The energizing leads may then be attached to the phase lead and the neutral. It is also possible to attach the energizing leads to each of the paralleled sections, but this defeats the time saving feature of the Cap Check.

Other arrangements of jumpers or switching can be devised to suit the network under test.

When the system consists of paralleled series-parallel groups it probably will not be necessary to switch or jumper the parallel leg – as a matter of fact, that leg must not be shorted or too much of it jumped to avoid drawing excessive power from the tester.

After the test of all parallel groups is completed the tester voltage should be turned down to minimum and the supply should be de-energized. This action will discharge the capacitors which were last tested.

DESIGN OF THE PROCEDURE

The objectives to be considered when establishing a test procedure must put safety irst and then consider the convenience and efficiency of the work crew. The basic consideration will be to minimize the number of jumper shifts during the course of testing.

PROCEDURE REVIEW

HD Electric will be happy to discuss special problem networks or to review proposed test sequences, but the responsibility for the safe design of these procedures and the safe operation of the test set lies with the using authority.

INTRODUCTION

This Substation Capacitor Checker applies a low AC, 60 Hz voltage to a group of parallel-connected capacitor units. Capacitors are measured individually with a clamp-type ammeter probe to determine if the capacitor units have a defect. The defect may be either a partial or complete short or an open pack. To test the entire capacitor bank, the test voltage energizing leads must be moved around the capacitor bank and connected to each group of parallel capacitors. The capacitors being tested remain connected to the bus through their individual fuses.

EXCEPTION: A capacitor which has its individual fuse blown will not be energized when voltage is applied to the main bus.

STEP 1. Verify that the capacitor bank is out of service and isolated from its source. If the capacitor bank is in service, open the source device and wait a full five (5) minutes for the capacitors to discharge. Then temporarily short circuit the capacitors with the bank shorting switch. Ground the bank according to the approved methods. Note: Capacitor structures and associated shorting and grounding devices vary between locations.

FOR TESTING CAPACITORS WITH BLOWN FUSES

Capacitor units which have had their protective fuses blown must be temporarily shorted and grounded on an individual basis and test leads subsequently connected to each capacitor. To obtain the individual capacitor reading, clamp the Current Transformer around the ground lead from the capacitor under test. See the following instructions.

STEP 2. Disconnect and remove the following type capacitors from the bank:

1. Any visually bulged units.
2. Any unit which shows an insulating liquid leak. These leaks may occur at the phase bushings, the neutral attachment, the fill hole or a seam. Any loss in insulating liquid may result in an internal flashover to the case and possible case rupture. The packs and leads are very confined and a void in the insulating liquid can precipitate a failure.

A leaking capacitor may test OK because a pack hasn't completely shorted or open. However, the gas generated from a pack in the process of failing can cause tank swelling or force liquid out a weakened seal or seam.

SAFETY PLEASE NOTE

A CAPACITOR MUST BE SHORT CIRCUITED AT THE TERMINALS BEFORE IT CAN BE CONSIDERED DE-ENERGIZED.

STEP 3. Suggested Cap Check Hookup Procedure

A. Connect the Cap Check cabinet ground to the station ground.

B. Plug the polarized plug of the Energizing Leads into the Cap Check. Connect the energizing leads via live line clamp to the section of bank to be checked (red clamp to phase bus, black to neutral bus). Use rigorous and approved hot stick work precautions.

C. Verify that the Cap Check On/Off switch is in the OFF position and that the Variable Transformer is at zero (0).

D. Connect the Cap Check power supply cord to a 120-volt outlet (120 volt, 20-amp circuit required). Adapter pigtails are provided for twist-lock and non-twist-lock connectors.

STEP 4. A. Outdoor Substation Racks

Attach the Current Transformer to the hot stick to permit measuring individual capacitors while the operator stands at ground level. The hot stick consists of four eight-foot sections. Also assemble the Actuating Rope.

B. Pad Mounted Enclosure Capacitor Rack

The Current Transformer may be operated without the hot stick, but rubber gloves are required because bare connections are energized at 120 volts. Hot sticks are still advised under all conditions.

STEP 5. Determine the rating of the capacitors under test and determine the test voltage to be applied by referencing the Pass/Fail Limit Rating Chart located at the end of the manual. Set the Test Voltage Selection Switch to the correct position for that voltage. Note: It is possible to attain the 50 and 120 Volt setting in the 240 Plus position. This action can yield incorrect readings and can cause serious damage to the internal components of this tester.

STEP 6. With the Variable Transformer at zero turn the Cap Check on. The digital meters will light and may flash at random for a few seconds. Slowly advance the Variable Transformer and observe the rate of voltage and current increase. If the input circuit breaker trips, an overload is indicated. This condition will rarely be found in banks with individually fused capacitors. It is a likely occurrence when testing isolated capacitors. A completely shorted capacitor is the extreme case of this type.

If this condition is found, try searching with a lower than listed voltage using the Current Transformer. The bad capacitor will have a very high current when compared to good capacitors. Do not attempt a long search unless some other clamp-on current meter is used to limit the search current to 8 amperes at 50 volts and even then, do not exceed 30 minutes.

When measuring suspected individual capacitors that are disconnected from the bank, place the Current Transformer on the bushing prior to applying the test voltage. Shorted capacitors will provide high current readings even with less than normal testing voltage.

STEP 7. Verify with the Current Transformer that each capacitor is within the range specified on the Pass/Fail Limit Rating Chart.

NOTE: Capacitors which have low readings may have open packs or corroded terminals, either on the capacitor or at the fuse connection to the bus. Corrosion results in an excessive voltage drop and an incorrect reading. Wire brush the connections and reconduct the test if this is observed. Values ABOVE the accepted range indicate one or more groups of packs are shorted. Replace the units not in the acceptable range indicated on the Pass/Fail Limit Rating Chart.

STEP 8. When the group check is complete, return the Variable Transformer to zero to short out the capacitors. Turn the Cap Check off.

STEP 9. Repeat Steps 1 – 8 for the remaining groups to be tested.

STEP 10. Upon completion of the test, store the leads in the appropriate storage area in the Cap Check.

NOTE: The unit is not weatherproof. Exercise care to prevent moisture damage.

SERIES-PARALLEL GROUP TESTS

The use of series-parallel capacitor groups is common to obtain the necessary voltage and capacity ratings for substation banks.

The Cap Check has been designed to test these capacitor groups without the need for disconnecting any leads. The series connection of parallel groups may require the use of some shorting jumpers or movement of the energizing lead connection points.

It is necessary that the energizing voltage appear directly across the capacitors under test. It is necessary to locate the leads or jumpers to accomplish this.

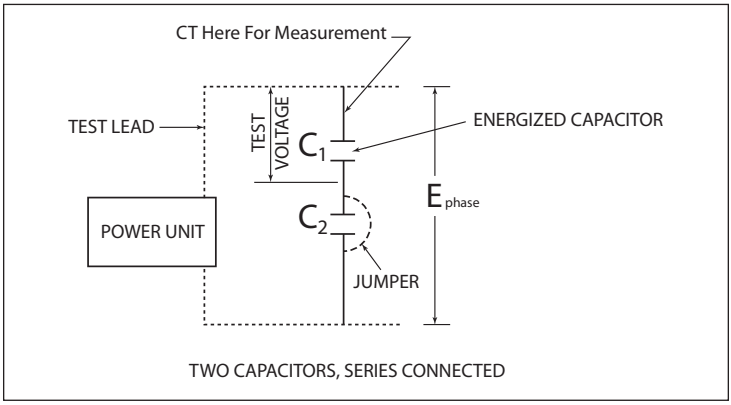


Figure 1

FIGURE 1 shows a pair of series connected capacitors.

By definition, $C = 1/(1/C1 + 1/C2)$ and $KVAR = 2\pi fC\,(kV)^2 \times 10^{-3}$; C in μFd.

We may calculate the following for a selected case:

VOLTAGE	KVAR	C FD	
7960	100	4.19;	two such units in series give:
15920	200*	2.10;	* the 200 KVAR has been calculated for the 2.1 μFd

Therefore, when two identical capacitors are connected in series to permit operation at a doubled voltage, the KVAR value will be the sum of the total KVAR rating of the two units.

The energizing leads may be placed across the group of capacitors under test as shown in **FIGURE 2** below. This will place the balance of the groups in series and reduce the current load presented by them. The loading effect of these capacitors strung in series will be equal to 1/n x group KVAR; where n is the number of groups in series loading the power unit. In the case shown in Figure 2, the loading effect would be ¼ x group KVAR.

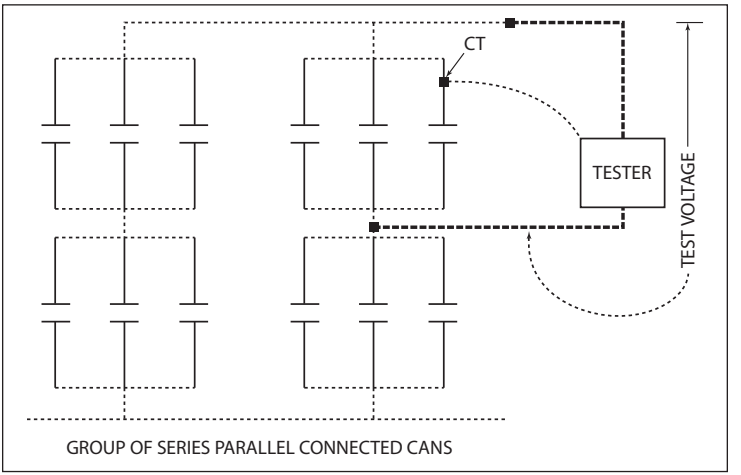


Figure 2

FIGURE 3 below shows the same group of capacitors with a different energizing lead connection, which would require the use of a jumper. This would increase the effective load on the power unit. If the bank load does not exceed the capacity of the unit, any connection arrangement may be used.

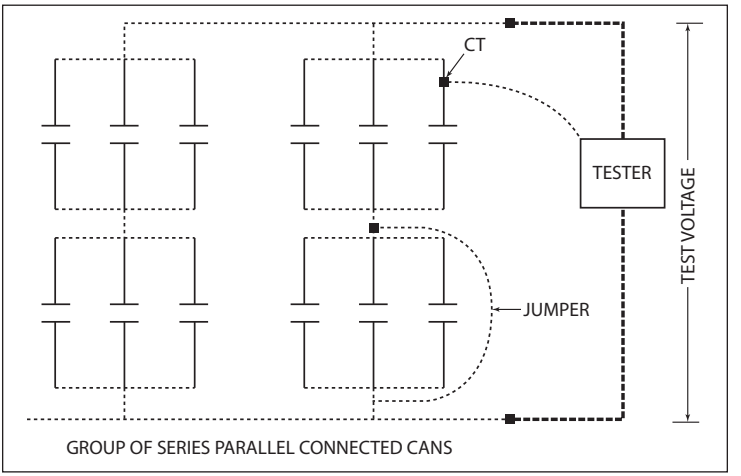


Figure 3

The Pass/Fail Limit Rating Chart at the end of the manual provides a maximum load per phase for the Cap Check. These values are for continuous duty and some overload capacity is available.

HD Electric will be happy to review questions presented regarding jumper arrangements and the load capacity of the Cap Check, but cannot assume responsibility for safe operation and the design of operating procedures.

CAP CHECK II PASS / FAIL LIMIT RATING

NAMEPLATE DATA			TEST CURRENT		MAXIMUM ENERGIZED
V	KVAR	V TEST	I MIN	I MAX	BANK LOAD, KVAR
2200	15	50	0.141	0.189	1050
2200	25	50	0.235	0.315	
2200	50	50	0.470	0.630	
2200	100	50	0.940	1.260	
2200	150	50	1.410	1.890	
2200	300	50	2.820	3.781	
2200	600	50	5.640	7.562	
2400	15	50	0.118	0.159	1250
2400	25	50	0.197	0.265	
2400	50	50	0.395	0.530	
2400	100	50	0.790	1.059	
2400	150	50	1.185	1.589	
2400	200	50	1.580	2.118	
2400	400	50	3.160	4.236	
2400	800	50	6.319	8.472	
2400	15	120	0.284	0.381	500
2400	25	120	0.474	0.635	
2400	50	120	0.948	1.271	
2400	100	120	1.896	2.542	
2400	200	120	3.792	5.083	
4000	50	50	0.142	0.191	3550
4000	100	50	0.284	0.381	
4000	150	50	0.427	0.572	
4000	200	50	0.569	0.763	
4000	400	50	1.138	1.525	
4000	800	50	2.275	3.050	
4000	15	120	0.102	0.137	1450
4000	25	120	0.171	0.229	
4000	50	120	0.341	0.458	
4000	100	120	0.683	0.915	
4000	200	120	1.365	1.830	
4000	400	120	2.730	3.660	

CAP CHECK II PASS / FAIL LIMIT RATING continued

NAMEPLATE DATA			TEST CURRENT		MAXIMUM ENERGIZED
V	KVAR	V TEST	MIN	MAX	BANK LOAD, KVAR
4160	50	50	0.131	0.176	3850
4160	100	50	0.263	0.352	
4160	150	50	0.394	0.529	
4160	200	50	0.526	0.705	
4160	400	50	1.052	1.410	
4160	800	50	2.103	2.820	
4160	15	120	0.095	0.127	1600
4160	25	120	0.158	0.211	
4160	50	120	0.316	0.423	
4160	100	120	0.631	0.846	
4160	200	120	1.262	1.692	
4160	400	120	2.524	3.384	
4800	50	50	0.099	0.132	5150
4800	100	50	0.197	0.265	
4800	150	50	0.296	0.397	
4800	200	50	0.395	0.530	
4800	400	50	0.790	1.059	
4800	800	50	1.580	2.118	
4800	15	120	0.071	0.095	2100
4800	25	120	0.118	0.159	
4800	50	120	0.237	0.318	
4800	100	120	0.474	0.635	
4800	200	120	0.948	1.271	
4800	400	120	1.896	2.542	
6640	15	300	0.093	0.125	1600
6640	15	120	0.037	0.050	4100
6640	25	120	0.062	0.083	
6640	50	120	0.124	0.166	
6640	100	120	0.248	0.332	
6640	150	120	0.372	0.498	
6640	200	120	0.495	0.664	
6640	400	120	0.991	1.328	
6640	800	120	1.981	2.656	
7200	15	300	0.079	0.106	1900

CAP CHECK II PASS / FAIL LIMIT RATING continued

NAMEPLATE DATA			TEST CURRENT		MAXIMUM ENERGIZED
V	KVAR	V TEST	MIN	MAX	BANK LOAD, KVAR
7200	25	120	0.053	0.071	4800
7200	50	120	0.105	0.141	
7200	100	120	0.211	0.282	
7200	150	120	0.316	0.424	
7200	200	120	0.421	0.565	
7200	300	120	0.632	0.847	
7200	600	120	1.264	1.694	
7200	1200	120	2.528	3.389	
7300	100	120	0.205	0.275	4950
7300	150	120	0.307	0.412	
7300	200	120	0.410	0.549	
7300	300	120	0.615	0.824	
7300	600	120	1.229	1.648	
7300	1200	120	2.459	3.297	
7620	15	300	0.071	0.095	2150
7620	25	300	0.118	0.158	
7620	50	120	0.094	0.126	5400
7620	100	120	0.188	0.252	
7620	150	120	0.282	0.378	
7620	200	120	0.376	0.504	
7620	300	120	0.564	0.756	
7620	600	120	1.128	1.513	
7620	1200	120	2.257	3.026	
7960	15	300	0.065	0.087	2350
7960	25	300	0.108	0.144	
7960	50	120	0.086	0.116	5900
7960	100	120	0.172	0.231	
7960	150	120	0.259	0.347	
7960	200	120	0.345	0.462	
7960	400	120	0.689	0.924	
7960	800	120	1.379	1.848	
8320	15	300	0.059	0.079	2550
8320	25	300	0.099	0.132	

CAP CHECK II PASS / FAIL LIMIT RATING continued

NAMEPLATE DATA			TEST CURRENT		MAXIMUM ENERGIZED
V	KVAR	V TEST	MIN	MAX	BANK LOAD, KVAR
8320	50	120	0.079	0.106	6450
8320	100	120	0.158	0.211	
8320	150	120	0.237	0.317	
8320	200	120	0.316	0.423	
8320	400	120	0.631	0.846	
8320	800	120	1.262	1.692	
9960	200	50	0.092	0.123	22150
9960	300	50	0.138	0.184	
9960	100	120	0.110	0.148	9200
9960	150	120	0.165	0.221	
9960	200	120	0.220	0.295	
9960	300	120	0.330	0.443	
9960	600	120	0.660	0.885	
9960	1200	120	1.321	1.771	
10300	100	120	0.103	0.138	9850
10300	150	120	0.154	0.207	
10300	200	120	0.206	0.276	
10300	400	120	0.412	0.552	
10300	800	120	0.823	1.104	
10800	200	120	0.187	0.251	10850
13200	25	480	0.063	0.084	4050
13200	50	480	0.125	0.168	
13200	100	480	0.251	0.336	
13200	50	300	0.078	0.105	6450
13200	100	300	0.157	0.210	
13200	150	120	0.094	0.126	16200
13200	200	120	0.125	0.168	
13200	400	120	0.251	0.336	
13200	800	120	0.501	0.672	
13280	50	300	0.077	0.104	6550
13280	100	300	0.155	0.208	
13280	150	300	0.232	0.311	

CAP CHECK II PASS / FAIL LIMIT RATING continued

NAMEPLATE DATA			TEST CURRENT		MAXIMUM ENERGIZED
V	KVAR	V TEST	MIN	MAX	BANK LOAD, KVAR
13280	100	120	0.062	0.083	16400
13280	150	120	0.093	0.125	
13280	200	120	0.124	0.166	
13280	300	120	0.186	0.249	
13280	600	120	0.372	0.498	
13280	1200	120	0.743	0.996	
13800	25	480	0.057	0.077	4400
13800	50	480	0.115	0.154	
13800	50	300	0.072	0.096	7100
13800	100	300	0.143	0.192	
13800	100	120	0.057	0.077	17750
13800	150	120	0.086	0.115	
13800	200	120	0.115	0.154	
13800	400	120	0.229	0.307	
13800	800	120	0.459	0.615	
14400	25	480	0.053	0.071	4800
14400	50	480	0.105	0.141	
14400	100	480	0.211	0.282	
14400	50	300	0.066	0.088	7700
14400	100	300	0.132	0.177	
14400	100	120	0.053	0.071	19300
14400	150	120	0.079	0.106	
14400	200	120	0.105	0.141	
14400	300	120	0.158	0.212	
14400	600	120	0.316	0.424	
14400	1200	120	0.632	0.847	
15200	150	120	0.071	0.095	21500
16000	200	120	0.085	0.114	23850
17000	300	300	0.283	0.380	10750
19920	200	120	0.055	0.074	36950
19920	300	120	0.083	0.111	

CAP CHECK II PASS / FAIL LIMIT RATING continued

NAMEPLATE DATA			TEST CURRENT		MAXIMUM ENERGIZED
V	KVAR	V TEST	MIN	MAX	BANK LOAD, KVAR
19920	50	480	0.055	0.074	9200
19920	100	480	0.110	0.148	
19920	150	300	0.103	0.138	14750
19920	200	300	0.138	0.184	
19920	300	300	0.206	0.277	
21600	150	300	0.088	0.118	17400
21600	200	300	0.117	0.157	
21600	50	480	0.047	0.063	10850
21600	100	480	0.094	0.126	
21600	150	480	0.140	0.188	
21600	200	480	0.187	0.251	
22130	100	480	0.089	0.120	11400
22130	150	480	0.134	0.179	
22130	200	480	0.178	0.239	
22500	50	480	0.043	0.058	11800
22500	100	480	0.086	0.116	
22500	150	480	0.129	0.174	
22500	200	480	0.173	0.231	
25000	100	480	0.070	0.094	14550
25000	150	480	0.105	0.141	
25000	200	480	0.140	0.187	

NOTE: Maximum Energized Bank Load, KVAR refers to the capacitors which the Cap Check II can energize as a group. The operating manual includes information on load calculations for series-parallel connected banks.

When more than one test voltage is listed for a capacitor nameplate rating, select the highest value while considering the Cap Check bank capacity rating.

REPAIRS

If any damage is found please contact us at 800-435-0786 to arrange for service.

TERMS AND CONDITIONS OF SALE

HD Electric Company is herein referred to either as "HDE" or "Seller" and the customer or person or entity purchasing goods or services (hereinafter collectively referred to as "Goods") is referred to as the "Buyer". These Terms and Conditions, any price list or schedule, quotation, acknowledgment or invoice from HDE relevant to the sale of the Goods and all documents incorporated by specific reference therein, constitute the complete and exclusive statement of the terms of the agreement governing the sale of Goods by HDE to Buyer. Buyer's acceptance of the Goods will manifest Buyer's assent to these terms and conditions without variation or addition. Any different or additional terms in Buyer's purchase order or other Buyer documents are hereby objected to. HDE reserves the right in its sole discretion to refuse orders.

1. PRICES AND TAXES: Unless a fixed price is quoted, the price at which this order is accepted is subject to adjustment to HDE's price in effect at the time of order. Any current or future tax or governmental charge (or increase in same) affecting Seller's costs or production, sale or delivery or which Seller is otherwise required to pay or collect in connection with the sale, purchase, delivery, storage, processing, use or consumption of Goods (but excluding any tax on Seller's net income or profit) shall be for Buyer's account and shall be added to the price.

2. TERMS OF PAYMENT: Terms are stated on HDE's invoice in U.S. currency. HDE shall have the right, among other remedies, either to terminate this agreement or to suspend further performance under this and/or other agreements with the Buyer in the event Buyer fails to make any payment when due, which other agreements Buyer and Seller hereby amend accordingly, or HDE otherwise deems itself insecure. Buyer shall be liable for all expenses, including attorneys' fees, relating to the collection of past due amounts. Should Buyer's financial responsibility become unsatisfactory to HDE, cash payments or security satisfactory to HDE may be required by HDE for future deliveries and for the goods theretofore delivered. If such cash payment or security is not provided, in addition to HDE's other rights and remedies, HDE may discontinue deliveries. HDE may apply a finance charge for payments made by credit card.

3. SHIPMENT AND DELIVERY: Unless otherwise expressly provided, shipments are made F.O.B. HDE's shipping point. Risk of loss or damage and responsibility shall pass from HDE to Buyer upon delivery to and receipt by common carrier. Any claims for shortages or damages suffered in transit are the responsibility of Buyer and shall be submitted by the Buyer directly to the carrier. Shortages or damages must be acknowledged and signed for at the time of delivery. While HDE will use all reasonable commercial efforts to maintain the delivery date(s) acknowledged or quoted by HDE, all shipping dates are approximate and not guaranteed. HDE reserves the right to make partial shipments. HDE, at its option, shall not be bound to tender delivery of any Goods for which Buyer has not provided shipping instructions. If the shipment of the Goods is postponed or delayed by Buyer for any reason, Buyer agrees to reimburse HDE for any and all handling and storage costs and other additional expenses resulting therefrom. All claims for shipping errors, lost shipments or any other discrepancies must be made within ninety (90) days or they will be disallowed and deemed waived.

4. HDE LIMITED WARRANTY: HDE covers its products with a manufacturer's warranty against defects in material or workmanship for a period of ten years in the case of Capacitor Controls and in all other circumstances for a period of one year, unless otherwise stated by HDE in writing. To take advantage of this warranty, the complete product must be delivered prepaid to HDE or any HDE Authorized Service Center. This warranty shall not apply to any Goods including but not limited to products which: (a) Have been repaired or altered outside HDE's factory (or Authorized Service Center) or in any manner so as, in HDE's judgment, to affect its serviceability or proper operation; (b) Have been subjected by persons other than HDE (or Authorized Service Center) to improper handling, operation, maintenance, repair or alteration; and, (c) Have been subjected to normal wear and tear, misuse, negligence, improper installation or accident. HDE's obligation under this warranty, and the Buyer's exclusive remedy for the breach thereof, shall be limited to, at HDE's option, repair or replacement of any allegedly defective Goods or issuance of credit. HDE requires the return of any allegedly defective Goods, transportation prepaid, before honoring any claim. All returned Goods are subject to inspection, and if examination does not disclose any defect covered by this warranty, replacement of such Goods or issuance of credit for same will not be approved. THE FOREGOING CONSTITUTES HDE'S SOLE WARRANTY RESPONSIBILITY AND BUYER'S EXCLUSIVE REMEDY WHETHER SOUNDING IN TORT, CONTRACT, STRICT LIABILITY OR OTHERWISE, EXCEPT AS OTHERWISE EXPRESSLY SET FORTH IN THIS AGREEMENT. THERE ARE NO OTHER WARRANTIES, EXPRESS OR IMPLIED, WHETHER OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR OTHERWISE. No employee, agent, dealer, or other person is authorized to give any warranty on behalf of HDE. This warranty extends only to persons or organizations who purchase the Goods from HDE for resale.

5. LIMITATION OF REMEDY AND LIABILITY: THE SOLE AND EXCLUSIVE REMEDY FOR BREACH OF ANY WARRANTY HEREUNDER SHALL BE LIMITED TO REPAIR, CORRECTION, REPLACEMENT OR CREDIT UNDER SECTION 4. HDE SHALL NOT BE LIABLE FOR DAMAGES CAUSED BY DELAY IN PERFORMANCE, AND IN NO EVENT, REGARDLESS OF THE FORM OF THE CLAIM OR CAUSE OF ACTION (WHETHER BASED IN CONTRACT, INFRINGEMENT, NEGLIGENCE, STRICT LIABILITY, OTHER TORT OR OTHERWISE), SHALL HDE'S LIABILITY TO BUYER AND/OR ITS CUSTOMERS EXCEED THE PRICE PAID BY BUYER FOR THE SPECIFIC GOODS GIVING RISE TO THE CLAIM OR CAUSE OF ACTION, AND BUYER SHALL INDEMNIFY HDE FOR ANY DAMAGES IN EXCESS THEREOF. BUYER AGREES THAT IN NO EVENT SHALL HDE'S LIABILITY TO BUYER AND/OR ITS CUSTOMERS INCLUDE SPECIAL, INDIRECT, INCIDENTAL, CONSEQUENTIAL OR PUNITIVE DAMAGES OF ANY CHARACTER IN CONNECTION WITH THE SALE, RESALE OR USE OF THE GOODS, WHICH ARE WAIVED BY BUYER AND AS TO WHICH BUYER SHALL INDEMNIFY HDE. The term "consequential damages" shall include, but not be limited to, loss of anticipated profits, business interruption, loss of use of revenue, cost of capital or loss of or damage to property, equipment, or data, or loss of reputation. Further, Buyer shall indemnify and hold HDE harmless from any liability to Buyer, Buyer's employees, workers, contractors or any other persons arising out of Buyer's, and any other persons', use of the Goods. All instructions and warnings supplied by HDE will be passed on to those persons who use the Goods. HDE's Goods are to be used in their recommended applications and all warning labels adhered to the Goods by HDE shall be left intact. It is impossible to eliminate all risks associated with the use of the Goods. Risks of serious injury or death, including risks associated with electrocution, arcing and thermal burns, are inherent in work in and around energized electrical systems. Such risks arise from the wide variety of electrical systems and equipment to which Goods may be applied, the manner of use or application, weather and environmental conditions or other unknown factors, all of which are beyond the control of HDE. HDE does not agree to be an insurer of these risks, and shall have no liability for any claims arising from such risks. WHEN YOU BUY OR USE THESE PRODUCTS, YOU AGREE TO ACCEPT THESE RISKS.

6. EXCUSE OF PERFORMANCE (FORCE MAJEURE): HDE shall not be liable for delays in performance or for non-performance due to acts of God; acts of Buyer; war; fire; flood; weather; sabotage; strikes, labor disputes, civil disturbances or riots; governmental requests, restrictions, allocations, laws, regulations, orders or actions; unavailability of or delays in transportation; default of suppliers; or unforeseen circumstances or events beyond HDE's reasonable control. Deliveries or other performance may be suspended for an appropriate period or cancelled by HDE upon notice to Buyer in the event of any of the foregoing, but the balance of this agreement shall otherwise remain unaffected. If HDE determines that its ability to supply the total demand for the Goods, or to obtain material used directly or indirectly in the manufacture of the Goods, is hindered, limited or made impracticable due to causes set forth herein, HDE may allocate its available supply of the Goods or such material (without obligation to acquire other supplies of any such Goods or materials) among itself and its purchasers on such basis as HDE determines to be equitable without liability for any failure of performance which may result therefrom.

7. CHANGES: HDE reserves the right to change designs and specifications for standard Goods without prior notice to Buyer, but not with respect to custom Goods being made for Buyer. HDE shall have no obligation to install or make such change in any Goods manufactured prior to the date of such change.

8. ASSIGNMENT: Buyer shall not assign its rights or delegate its duties hereunder or any interest herein without the prior written consent of HDE, and any such assignment, without such consent, shall be void.

9. INSTALLATION: Buyer shall be responsible for receiving, inspecting, testing, storing, installing, starting up and maintaining all Goods.

10. INSPECTION/TESTING: Buyer, at its expense, agrees that it will promptly inspect the Goods upon receipt thereof, and in no event later than thirty (30) days from the date of receipt of the Goods. Buyer shall deliver to HDE within fifteen (15) days of inspection, but in no event later than forty-five (45) days from the date of receipt of the Goods, written notice of any and all deficiencies, defects, variations from specifications or complaints of any kind with respect to the quantity, quality, condition, shipment, performance, price or appearance of the Goods so received by Buyer. In the event no such written notice is received by HDE, Buyer shall be deemed conclusively to have inspected and accepted all such Goods unconditionally and to have waived any and all rights and claims, including without limitation any right to reject the Goods or to claim damages in respect thereof. Buyer may not return goods without first advising HDE of the reasons therefore, obtaining from HDE a material authorization number and observing such instructions as HDE may give in authorizing such return. In the event a return is authorized by HDE, a restocking for any Goods requiring repackaging or maintenance a twenty percent (20%) restocking fee shall be assessed to Buyer in the final credit amount.

11. SERVICES: If this agreement requires HDE to perform or provide any services, HDE (including without limitation its successors, assigns, agents or any person or entity acting at HDE's direction) shall not be responsible for any damages, claims, liabilities or expenses of any nature arising out of such services.

12. U.S. EXPORT CONTROL LAWS: All Goods sold to Buyer by HDE hereunder are subject to U.S. Export Control Laws. Buyer hereby agrees not to re-sell or divert any goods contrary to such laws.

13. COMPLIANCE: Seller/Contractor shall comply with all applicable federal, state or local laws, rules, regulations, or orders. Seller/Contractor shall comply with Executive Order 11246, as amended by Executive Order 11375, and the applicable provisions of the Office of Federal Contract Compliance Programs (OFCCP), 41 CFR Part 60, which are incorporated herein by this reference. Buyer shall comply with all applicable federal, state, or local laws, rules, regulations or orders including but not limited to the Foreign Corrupt Practices Act of 1977, as amended. HDE reserves the right to delay or refuse delivery if requests for reasonable assurances of Buyer's compliance are not tendered as requested.

14. MISCELLANEOUS: These terms and conditions supersede all other communications, negotiations and prior oral or written statements regarding the subject matter hereof. No change, modification, rescission, discharge, abandonment, or waiver of these terms and conditions shall be binding upon HDE unless made in writing and signed on its behalf by its duly authorized representative. No conditions, usage or trade, course of dealing or performance, understanding or agreement purporting to modify, vary, explain, or supplement these terms and conditions shall be binding unless hereafter made in writing and signed by Seller. No modification shall be effected by HDE's receipt or acceptance of Buyer's purchase orders, shipping instruction forms, of other documentation containing terms at variance with or in addition to those set forth herein, all of which are objected to by HDE. Any such modifications or additional terms are specifically rejected by HDE. No waiver by HDE with respect to any breach or default of any right or remedy and no course of dealing, shall be deemed to constitute a continuing waiver of any other breach or default of any other right or remedy, unless such waiver be expressed in writing and signed by HDE. All typographical or clerical errors made by HDE in any quotation, acknowledgment or publication are subject to correction. Validity and performance relating to the interpretation and effect of this agreement shall be governed by the laws of the state of Illinois without regard to its conflict of law principles.

15. DISPUTE RESOLUTION: In the event of any dispute INCLUDING, BUT NOT LIMITED TO, BREACH OF CONTRACT, BREACH OF WARRANTY, CLAIMS BASED IN TORT, NEGLIGENCE, PRODUCT LIABILITY, FRAUD, MARKETING, STATE OR FEDERAL REGULATIONS, ANY CLAIMS REGARDING THE ENFORCEABILITY OF THIS LIMITED WARRANTY, AND THE WAIVER OF CLASS ACTION TRIALS between Buyer and Seller, either may choose to resolve the dispute by binding arbitration, as described below, instead of in court. THIS MEANS IF EITHER BUYER OR SELLER CHOOSE BINDING ARBITRATION, NEITHER PARTY SHALL HAVE THE RIGHT TO LITIGATE SUCH CLAIM IN COURT OR HAVE A JURY TRIAL. DISCOVERY AND APPEAL RIGHTS ARE LIMITED IN BINDING ARBITRATION. Buyer and Seller agree that the proper venue if Arbitration is not so chosen by Buyer or Seller of all actions arising in connection herewith shall be only in the state of Illinois and the parties agree to submit to such jurisdiction. No action, regardless of form, arising out of transactions relating to the agreement, may be brought by either party more than two (2) years after the cause of action has accrued. The U.N. Convention on Contracts for the International Sales of Goods shall not apply to this agreement.

16. CLASS ACTION WAIVER: BINDING ARBITRATION MUST BE ON AN INDIVIDUAL BASIS. THIS MEANS NEITHER BUYER NOR SELLER MAY JOIN OR CONSOLIDATE CLAIMS IN ARBITRATION BY OR AGAINST OTHERS, OR LITIGATE IN COURT OR ARBITRATE ANY CLAIMS AS A REPRESENTATIVE OR MEMBER OF A CLASS OR IN A PRIVATE ATTORNEY GENERAL CAPACITY. ADMINISTRATION OF ARBITRATION: The binding arbitration must be administered by the American Arbitration Association ("AAA") in accordance with its Commercial Arbitration Rules and/or Supplementary Procedures for Consumer-Related Disputes (including proceedings to mitigate costs of travel). This binding arbitration is governed by the Federal Arbitration Act ("FAA") (9 USC §1, et. seq.) and will govern the interpretation and enforcement. The binding arbitration shall be held at a location determined by AAA or at such other location as mutually agreed. In addition to the terms stated above, the following will apply to the binding arbitration: (1) the arbitrator, and not any federal, state, or local court or agency, will have exclusive authority to resolve any dispute relating to the interpretation, applicability, enforceability or formation of this Agreement including any claim that all or any part of this Agreement is void or voidable; (2) the arbitrator shall apply Illinois law consistent with the FAA.

HD Electric Company is committed to ongoing review and improvement of its product lines, and thus reserves the right to modify product design and specifications without notice.

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