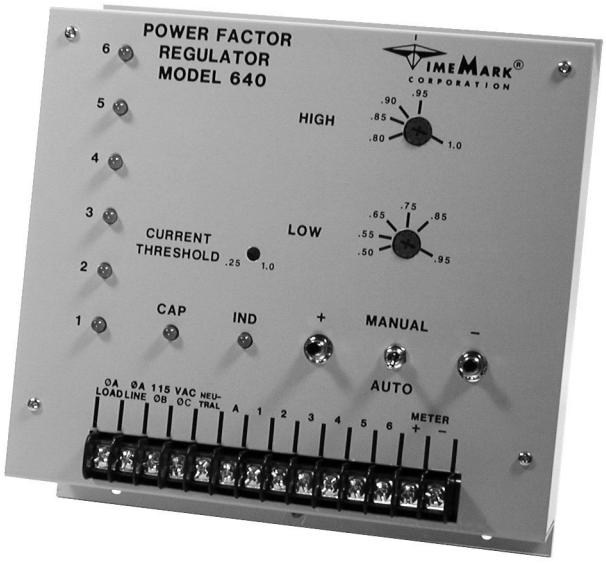
MODEL 640

Power Factor Regulator



- **High accuracy phase-angle sensing**
- **Adjustable limits**
- **Automatic/manual modes**
- **Activated steps indicators**
- **Capactive-inductive status LEDs**

DESCRIPTION

The **Model 640 Power Factor Regulator** is a monitoring and control factor correction system. It was designed to help obtain an improved power factor, with a minimum of added capacitors. This device uses a unique phase-angle sensing circuit to monitor the power factor of a 3-phase power line.

The Model 640 automatically responds to changing power factor by closing or opening the internal relays, which add or subtract capacitor banks on the line. Although intended for 115VAC 60Hz systems, other voltage or frequency models may be available.

OPERATION

The **Model 640** has a LOW POWER FACTOR control, adjustable between 0.50 and 0.95. If the power factor drops below this setting, the unit will begin adding capacitor stages each 40 seconds, until the high PF setting is reached. The HIGH POWER FACTOR control is adjustable between 0.80 and 1.00 and should always be set higher than the low setting. The Model 640 will drop out one stage of capacitors every 40 seconds if the power factor becomes capacitive (or leading too much capacitance). This continues until the power factor is again inductive (lagging).

A manual mode allows capacitance to be removed or added at the push of a button. If the operating voltage is lost or the input current is too low, all relays will drop out.

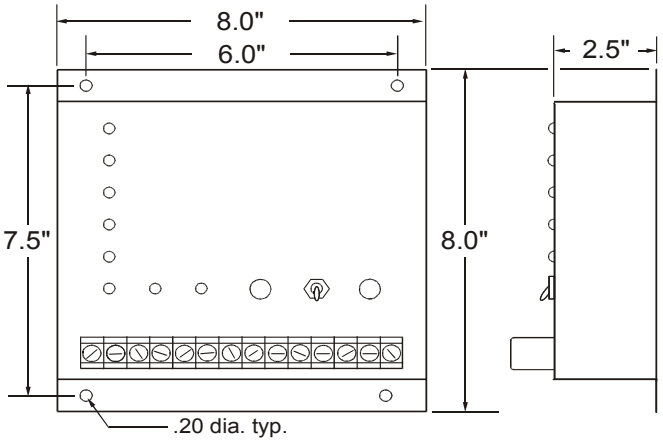
Indicator lights on the face of the Model 640 show if the power factor is inductive or capacitive. Output lights show relay status. An output is provided to drive a 1 mA DC meter.

Center scale on the meter will indicate a power factor of 1.0; a left deflection will indicate a capacitive power factor, while a right deflection will indicate an inductive power factor. Use of an external meter is optional.

SPECIFICATIONS

Model	640
Input voltage	115 VAC, 60Hz
Input current	Min: 0.25 to 1A adjustable Max: 5A continuous
Output contacts	2A at 240VAC resistive
Expected relay life	Mech: 10 million operations Elec: 100,000 at rated load
Adjustment	Low: 0.5 to 0.95 PF High: 0.8 to 1.0 PF
Time delay	40 seconds between steps
Enclosure material	20 gauge CRS
Weight	3.5 lbs

DIMENSIONS



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MODEL 640 Power Factor Regulator

READ ALL INSTRUCTIONS BEFORE INSTALLING, OPERATING OR SERVICING THIS DEVICE.
KEEP THIS DATA SHEET FOR FUTURE REFERENCE

GENERAL SAFETY

POTENTIALLY HAZARDOUS VOLTAGES ARE PRESENT AT THE TERMINALS OF THE MODEL 640. ALL ELECTRICAL POWER SHOULD BE REMOVED WHEN CONNECTING OR DISCONNECTING WIRING. THIS DEVICE SHOULD BE INSTALLED AND SERVICED BY QUALIFIED PERSONNEL.

Installation Instructions

POWER FACTOR DEFINED

The Power Factor, or PF, is stated as a decimal number between 0 and 1, and is the cosine of the angle between the voltage and current wave forms. In AC circuits, power (in watts) is defined as voltage x current x power factor. From this, you can see that with a power factor of 0 there can be no power, regardless of how large the voltage or current may be. A normal inductive motor will have a power factor between 0.30 and 0.90, depending on how the motor is loaded.

OPERATING THRESHOLDS

A current threshold adjustment is used to set the point where the Model 640 will disconnect all of the capacitors. This current threshold is adjustable between 0.25 and 1.00 amp, from the current transformer. This threshold sets the point below which the unit is inoperative. A power loss to the Model 640 will also cause all capacitors to be disconnected.

MANUAL OPERATION

The Model 640 can be operated manually. Capacitor stages can be added or subtracted with a push button on the front of the unit.

OPTIONAL DISPLAY METER

A meter signal is provided from the Model 640 for a DC meter with a 0-1 milliamp movement. The meter calibration will be:

0.1 ma = 0.50 power factor (capacitive)
0.5 ma = 1.00 power factor
0.9 ma = 0.50 power factor (inductive)

The meter output is nonlinear, i.e. 1.00 PF = 0.5 ma DC; 0.5 PF = 0.90 ma DC. Refer to **Chart 1.** for details.

HOW TO SELECT CAPACITORS

Power factor correcting capacitors and capacitor banks are normally rated in KVARS. There are three basic steps to properly size the capacitors to a given application:

Determine present load, measured in KW
Determine present power factor
Determine desired power factor

Using **Chart 2.** on page 4, locate the original (present) power factor in the vertical left-hand margin. Locate the desired (corrected) power factor across the top of the chart.

The correction factor (a three place decimal number) is denoted at the intersection of the row and column of these two figures.

The correction factor is next multiplied by the present KW load. The result is the required capacitor size, stated in KVAR. Correcting to a power factor of 0.95 is generally considered optimum; correcting to a leading, or capacitive, condition should not be attempted.

When the total KVAR requirement is determined, it can be divided among the six stages of the Model 640, to provide six-step power factor correction. **When installing capacitors, consult the manufacturer's literature for fusing and contactor requirements.**

In addition to the capacitors and contactors, a properly sized current transformer with a minimum burden rating of 2 VA and a 5 amp secondary is required. You will also need a power transformer with a 115 VAC secondary at 50 VA minimum. Proper phasing of CT and the PT is essential. If correction stages work in reverse, disconnect power and reverse the CT secondary leads.

TROUBLESHOOTING

Should this regulator fail to operate properly, check that all voltages are present and of the correct level. Check to see if all wiring is correct. If problems persist, contact the manufacturer at 800-862-2875; Monday thru Friday, 8 a.m. to 5 p.m. CST.

WARRANTY

This product is warranted to be free from defects in materials and workmanship for one year. Should this device fail to operate, we will repair it for one year from the date of manufacture. For complete warranty details, see the *Terms and Conditions of Sales* page in the front section of the Time Mark catalog or contact Time Mark at 1-800-862-2875.

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TIME MARK is a division of AEMT, Inc.

TYPICAL APPLICATION

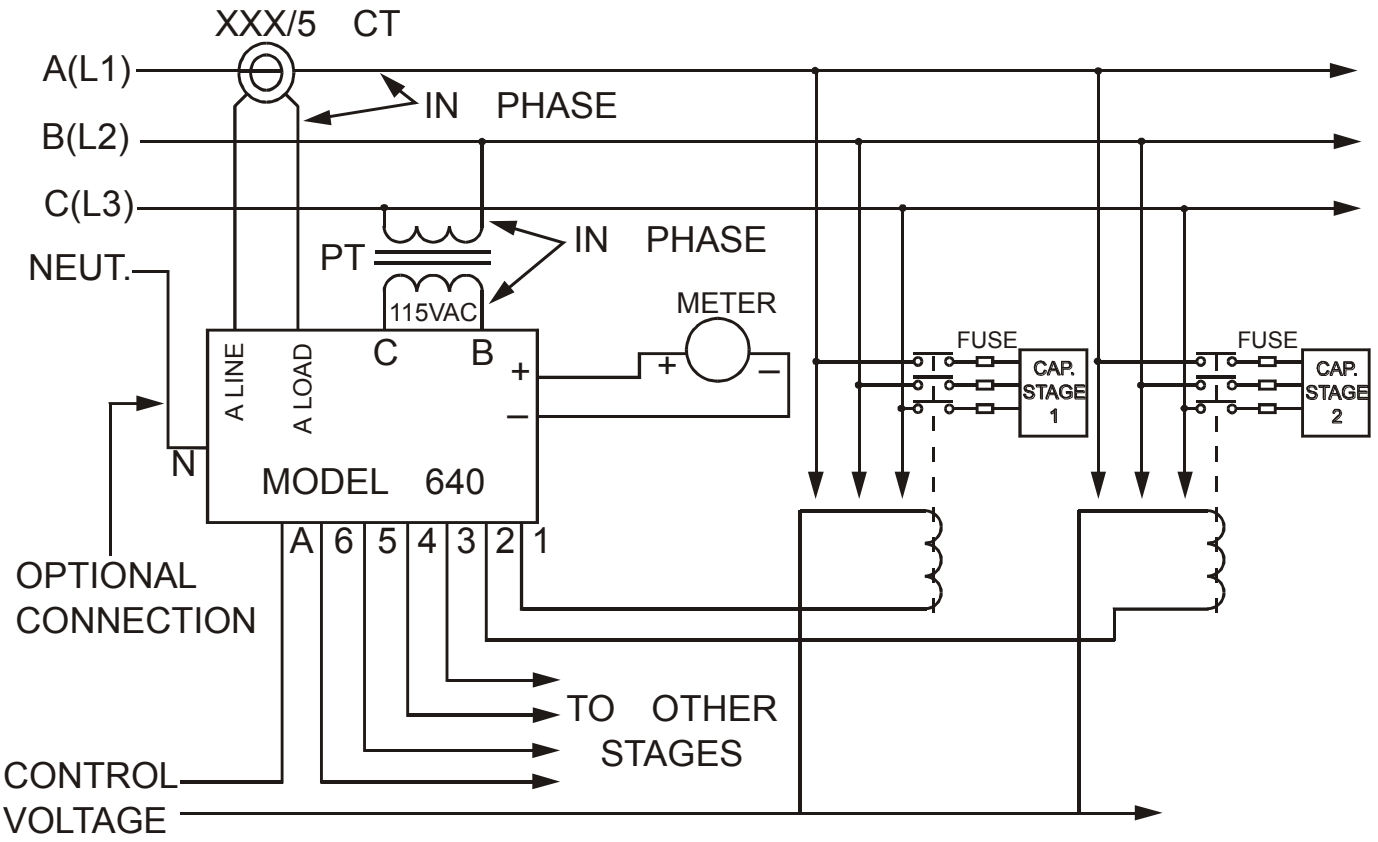

Chart 1. METER READING vs. POWER FACTOR		
Power Factor	**Capacitive Output (in mA)**	**Inductive Output (in mA)**
0.40	0.0571877	0.942812
0.45	0.0782908	0.921709
0.50	0.0999998	0.900000
0.55	0.122446	0.877554
0.60	0.145799	0.854201
0.65	0.170277	0.829723
0.70	0.196180	0.803820
0.75	0.223936	0.776064
0.80	0.254201	0.745799
0.85	0.288078	0.711922
0.90	0.327720	0.672280
0.95	0.378701	0.621299
1.00	0.500000	0.500000

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CHART 2. KW multipliers to determine capacitor kilovars required for power factor correction.

ORIG PF	CORRECTED POWER FACTOR																					
	0.80	0.81	0.82	0.83	0.84	0.85	0.86	0.87	0.88	0.89	0.90	0.91	0.92	0.93	0.94	0.95	0.96	0.97	0.98	0.99	1.00
0.50	0.982	1.008	1.034	1.060	1.086	1.112	1.139	1.165	1.192	1.220	1.248	1.276	1.306	1.337	1.369	1.403	1.440	1.481	1.529	1.589	1.732
0.51	0.937	0.962	0.989	1.015	1.041	1.067	1.094	1.120	1.147	1.175	1.203	1.231	1.261	1.292	1.324	1.358	1.395	1.436	1.484	1.544	1.687
0.52	0.893	0.919	0.945	0.971	0.997	1.023	1.050	1.076	1.103	1.131	1.159	1.187	1.217	1.248	1.280	1.331	1.351	1.392	1.440	1.500	1.643
0.53	0.850	0.876	0.902	0.928	0.954	0.980	1.007	1.033	1.060	1.088	1.116	1.144	1.174	1.205	1.237	1.277	1.308	1.349	1.397	1.457	1.600
0.54	0.809	0.835	0.861	0.887	0.913	0.939	0.966	0.992	1.019	1.047	1.075	1.103	1.133	1.154	1.196	1.230	1.267	1.308	1.356	1.416	1.559
0.55	0.769	0.795	0.821	0.847	0.873	0.899	0.926	0.952	0.979	1.007	1.035	1.063	1.093	1.124	1.156	1.190	1.227	1.268	1.316	1.376	1.519
0.56	0.730	0.756	0.782	0.808	0.834	0.860	0.887	0.913	0.940	0.968	0.996	1.024	1.054	1.085	1.117	1.151	1.188	1.229	1.277	1.337	1.480
0.57	0.692	0.718	0.744	0.770	0.796	0.822	0.849	0.875	0.902	0.930	0.958	0.986	1.016	1.047	1.079	1.113	1.150	1.191	1.239	1.299	1.442
0.58	0.655	0.681	0.707	0.733	0.759	0.785	0.812	0.838	0.865	0.893	0.921	0.949	0.979	1.010	1.042	1.076	1.113	1.154	1.202	1.262	1.405
0.59	0.619	0.645	0.671	0.697	0.723	0.749	0.776	0.802	0.829	0.857	0.885	0.913	0.943	0.974	1.006	1.040	1.077	1.118	1.166	1.226	1.369
0.60	0.583	0.609	0.635	0.661	0.687	0.713	0.740	0.766	0.793	0.821	0.849	0.877	0.907	0.938	0.970	1.004	1.041	1.082	1.130	1.190	1.333
0.61	0.549	0.575	0.601	0.627	0.653	0.679	0.706	0.732	0.759	0.787	0.815	0.843	0.873	0.904	0.936	0.970	1.007	1.048	1.096	1.156	1.299
0.62	0 516	0.542	0.568	0.594	0.620	0.646	0.673	0.699	0.726	0.754	0.782	0.810	0.840	0.871	0.903	0.937	0.974	1.015	1.063	1.123	1.266
0.63	0.483	0.509	0.535	0.561	0.587	0.613	0.640	0.666	0.693	0.721	0.749	0.777	0.807	0.838	0.870	0.904	0.941	0.982	1.030	1.090	1.233
0.64	0 451	0.474	0.503	0.529	0.555	0.581	0.608	0.634	0.661	0.689	0.717	0.745	0.775	0.806	0.838	0.872	0.909	0.950	0.998	1.068	1.201
0.65	0.419	0.445	0.471	0.497	0.523	0.549	0.576	0.602	0.629	0.657	0.685	0.713	0.743	0.774	0.806	0.840	0.877	0.918	0.966	1.026	1.169
0.66	0.388	0.414	0.440	0.466	0.492	0.518	0.545	0.571	0.598	0.626	0.654	0.682	0.712	0.743	0.775	0.808	0.846	0.887	0.935	0.995	1.138
0.67	0.358	0.384	0.410	0.436	0.462	0.488	0.515	0.541	0.568	0.596	0.624	0.652	0.682	0.713	0.745	0.779	0.816	0.857	0.905	0.965	1.108
0.68	0.328	0.354	0.380	0.406	0.432	0.458	0.485	0.511	0.538	0.566	0.594	0.622	0.652	0.683	0.715	0.749	0.786	0.827	0.875	0.935	1.078
0.69	0.299	0.325	0.351	0.377	0.403	0.429	0.456	0.482	0.509	0.537	0.565	0.593	0.623	0.654	0.686	0.720	0.757	0.798	0.846	0.906	1.049
0.70	0.270	0.296	0.322	0.348	0.374	0.400	0.427	0.453	0.480	0.508	0.536	0.564	0.594	0.625	0.657	0.691	0.728	0.769	0.817	0.877	1.020
0.71	0.242	0.268	0.294	0.320	0.346	0.372	0.399	0.425	0.452	0.480	0.508	0.536	0.566	0.597	0.629	0.663	0.700	0.741	0.789	0.849	0.992
0.72	0.214	0.240	0.266	0.292	0.318	0.344	0.371	0.397	0.424	0.452	0.480	0.508	0.538	0.569	0.601	0.635	0.762	0.713	0.761	0.821	0.964
0.73	0.186	0.212	0.238	0.264	0.290	0.316	0.343	0.369	0.396	0.424	0.452	0.480	0.510	0.541	0.573	0.607	0.644	0.685	0.733	0.793	0.936
0.74	0.159	0.185	0.211	0.237	0.263	0.289	0.316	0.342	0.369	0.397	0.425	0.453	0.483	0.514	0.546	0.580	0.617	0.658	0.706	0.766	0.909
0.75	0.132	0.158	0.184	0.210	0.236	0.262	0.289	0.315	0.342	0.370	0.398	0.426	0.456	0.487	0.519	0.553	0.590	0.631	0.679	0.739	0.882
0.76	0.105	0.131	0.157	0.183	0.209	0.235	0.262	0.288	0.315	0.343	0.371	0.399	0.429	0.460	0.492	0.526	0.563	0.604	0.652	0.712	0.855
0.77	0.079	0.105	0.131	0.157	0.183	0.209	0.236	0.262	0.289	0.317	0.345	0.373	0.403	0.434	0.466	0.500	0.537	0.578	0.626	0.685	0.829
0.78	0.052	0.078	0.104	0.130	0.156	0.182	0.209	0.235	0.262	0.290	0.318	0.346	0.376	0.407	0.439	0.473	0.510	0.551	0.599	0.659	0.802
0.79	0.026	0.052	0.078	0.104	0.130	0.156	0.183	0.209	0.236	0.264	0.292	0.320	0.350	0.381	0.413	0.447	0.484	0.525	0.573	0.633	0.776
0.80	0.000	0.026	0.052	0.078	0.104	0.130	0.157	0.183	0.210	0.238	0.266	0.294	0.324	0.355	0.387	0.421	0.458	0.499	0.547	0.609	0.750
0.81		0.000	0.026	0.052	0.078	0.104	0.131	0.157	0.184	0.212	0.240	0.268	0.298	0.329	0.361	0.395	0.432	0.473	0.521	0.581	0.724
0.82			0.000	0.026	0.052	0.078	0.105	0.131	0.158	0.186	0.214	0.242	0.272	0.303	0.335	0.369	0.406	0.447	0.495	0.555	0.698
0.83				0.000	0.026	0.052	0.079	0.105	0.132	0.160	0.188	0.216	0.246	0.277	0.309	0.343	0.380	0.421	0.469	0.529	0.672
0.84					0.000	0.026	0.053	0.079	0.106	0.134	0.162	0.190	0.220	0.251	0.283	0.317	0.354	0.395	0.443	0.503	0.646
0.85						0.000	0.027	0.053	0.080	0.108	0.136	0.164	0.194	0.225	0.257	0.291	0.328	0.369	0.417	0.477	0.620
0.86							0.000	0.026	0.053	0.081	0.109	0.137	0.167	0.198	0.230	0.264	0.301	0.342	0.390	0.450	0.593
0.87								0.000	0.027	0.055	0.083	0.111	0.141	0.172	0.204	0.238	0.275	0.316	0.364	0.424	0.567
0.88									0.000	0.028	0.056	0.084	0.114	0.145	0.177	0.211	0.248	0.289	0.337	0.397	0.540
0.89										0.000	0.028	0.056	0.086	0.117	0.149	0.183	0.220	0.261	0.309	0.369	0.512
0.90											0.000	0.028	0.058	0.089	0.121	0.155	0.192	0.233	0.281	0.341	0.484
0.91												0.000	0.030	0.061	0.093	0.127	0.164	0.205	0.253	0.313	0.456
0.92													0.000	0.031	0.063	0.097	0.134	0.175	0.223	0.283	0.426
0.93														0.000	0.023	0.066	0.103	0.144	0.192	0.252	0.395
0.94															0.000	0.034	0.071	0.112	0.160	0.220	0.363
0.95																0.000	0.037	0.079	0.126	0.186	0.329
0.96																	0.000	0.041	0.089	0.149	0.292
0.97																		0.000	0.048	0.108	0.251
0.98																			0.000	0.060	0.203
0.99																				0.000	0.143
1.00																					0.000

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