

How to calculate the power of capacitors (continued)

CAPACITOR POWER CALCULATION TABLE

> Conversion table

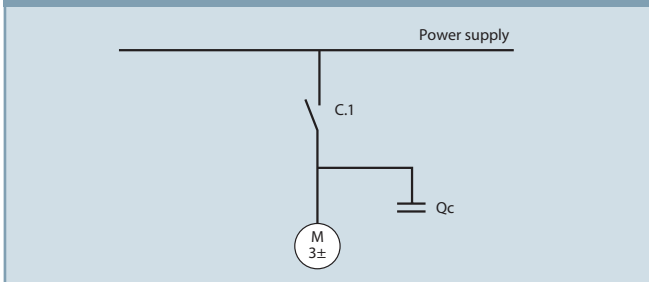
Based on the power of a receiver in kW, this table can be used to calculate the power of the capacitors to change from an initial power factor to a required power factor. It also gives the equivalence between $\cos \varphi$ and $\text{tg } \varphi$.

Final power factor		Capacitor power in kVAr to be installed per kW of load to increase the power factor to:										
$\cos \varphi$	$\text{tg } \varphi$	0.90	0.91	0.92	0.93	0.94	0.95	0.96	0.97	0.98	0.99	1
		0.48	0.46	0.43	0.40	0.36	0.33	0.29	0.25	0.20	0.14	0.0
0.40	2.29	1.805	1.832	1.861	1.895	1.924	1.959	1.998	2.037	2.085	2.146	2.288
0.41	2.22	1.742	1.769	1.798	1.831	1.840	1.896	1.935	1.973	2.021	2.082	2.225
0.42	2.16	1.681	1.709	1.738	1.771	1.800	1.836	1.874	1.913	1.961	2.002	2.164
0.43	2.10	1.624	1.651	1.680	1.713	1.742	1.778	1.816	1.855	1.903	1.964	2.107
0.44	2.04	1.558	1.585	1.614	1.647	1.677	1.712	1.751	1.790	1.837	1.899	2.041
0.45	1.98	1.501	1.532	1.561	1.592	1.626	1.659	1.695	1.737	1.784	1.846	1.988
0.46	1.93	1.446	1.473	1.502	1.533	1.567	1.600	1.636	1.677	1.725	1.786	1.929
0.47	1.88	1.397	1.425	1.454	1.485	1.519	1.532	1.588	1.629	1.677	1.758	1.881
0.48	1.83	1.343	1.370	1.400	1.430	1.464	1.467	1.534	1.575	1.623	1.684	1.826
0.49	1.78	1.297	1.326	1.355	1.386	1.420	1.453	1.489	1.530	1.578	1.639	1.782
0.50	1.73	1.248	1.276	1.303	1.337	1.369	1.403	1.441	1.481	1.529	1.590	1.732
0.51	1.69	1.202	1.230	1.257	1.291	1.323	1.357	1.395	1.435	1.483	1.544	1.686
0.52	1.64	1.160	1.188	1.215	1.249	1.281	1.315	1.353	1.393	1.441	1.502	1.644
0.53	1.60	1.116	1.144	1.171	1.205	1.237	1.271	1.309	1.349	1.397	1.458	1.600
0.54	1.56	1.075	1.103	1.130	1.164	1.196	1.230	1.268	1.308	1.356	1.417	1.559
0.55	1.52	1.035	1.063	1.090	1.124	1.156	1.190	1.228	1.268	1.316	1.377	1.519
0.56	1.48	0.996	1.024	1.051	1.085	1.117	1.151	1.189	1.229	1.277	1.338	1.480
0.57	1.44	0.958	0.986	1.013	1.047	1.079	1.113	1.151	1.191	1.239	1.300	1.442
0.58	1.40	0.921	0.949	0.976	1.010	1.042	1.073	1.114	1.154	1.202	1.263	1.405
0.59	1.37	0.884	0.912	0.939	0.973	1.005	1.039	1.077	1.117	1.165	1.226	1.368
0.60	1.33	0.849	0.878	0.905	0.939	0.971	1.005	1.043	1.083	1.131	1.192	1.334
0.61	1.30	0.815	0.843	0.870	0.904	0.936	0.970	1.008	1.048	1.096	1.157	1.299
0.62	1.27	0.781	0.809	0.836	0.870	0.902	0.936	0.974	1.014	1.062	1.123	1.265
0.63	1.23	0.749	0.777	0.804	0.838	0.870	0.904	0.942	0.982	1.030	1.091	1.233
0.64	1.20	0.716	0.744	0.771	0.805	0.837	0.871	0.909	0.949	0.997	1.058	1.200
0.65	1.17	0.685	0.713	0.740	0.774	0.806	0.840	0.878	0.918	0.966	1.007	1.169
0.66	1.14	0.654	0.682	0.709	0.743	0.775	0.809	0.847	0.887	0.935	0.996	1.138
0.67	1.11	0.624	0.652	0.679	0.713	0.745	0.779	0.817	0.857	0.905	0.966	1.108
0.68	1.08	0.595	0.623	0.650	0.684	0.716	0.750	0.788	0.828	0.876	0.937	1.079
0.69	1.05	0.565	0.593	0.620	0.654	0.686	0.720	0.758	0.798	0.840	0.907	1.049
0.70	1.02	0.536	0.564	0.591	0.625	0.657	0.691	0.729	0.796	0.811	0.878	1.020
0.71	0.99	0.508	0.536	0.563	0.597	0.629	0.663	0.701	0.741	0.783	0.850	0.992
0.72	0.96	0.479	0.507	0.534	0.568	0.600	0.634	0.672	0.721	0.754	0.821	0.963
0.73	0.94	0.452	0.480	0.507	0.541	0.573	0.607	0.645	0.685	0.727	0.794	0.936
0.74	0.91	0.425	0.453	0.480	0.514	0.546	0.580	0.618	0.658	0.700	0.767	0.909
0.75	0.88	0.398	0.426	0.453	0.487	0.519	0.553	0.591	0.631	0.673	0.740	0.882
0.76	0.86	0.371	0.399	0.426	0.460	0.492	0.526	0.564	0.604	0.652	0.713	0.855
0.77	0.83	0.345	0.373	0.400	0.434	0.466	0.500	0.538	0.578	0.620	0.687	0.829
0.78	0.80	0.319	0.347	0.374	0.408	0.440	0.474	0.512	0.552	0.594	0.661	0.803
0.79	0.78	0.292	0.320	0.347	0.381	0.413	0.447	0.485	0.525	0.567	0.634	0.776
0.80	0.75	0.266	0.294	0.321	0.355	0.387	0.421	0.459	0.499	0.541	0.608	0.750
0.81	0.72	0.240	0.268	0.295	0.329	0.361	0.395	0.433	0.473	0.515	0.582	0.724
0.82	0.70	0.214	0.242	0.269	0.303	0.335	0.369	0.407	0.447	0.489	0.556	0.698
0.83	0.67	0.188	0.216	0.243	0.277	0.309	0.343	0.381	0.421	0.463	0.530	0.672
0.84	0.65	0.162	0.190	0.217	0.251	0.283	0.317	0.355	0.395	0.437	0.504	0.645
0.85	0.62	0.136	0.164	0.191	0.225	0.257	0.291	0.329	0.369	0.417	0.478	0.602
0.86	0.59	0.109	0.140	0.167	0.198	0.230	0.264	0.301	0.343	0.390	0.450	0.593
0.87	0.57	0.083	0.114	0.141	0.172	0.204	0.238	0.275	0.317	0.364	0.424	0.567
0.88	0.54	0.054	0.085	0.112	0.143	0.175	0.209	0.246	0.288	0.335	0.395	0.538
0.89	0.51	0.028	0.059	0.086	0.117	0.149	0.183	0.230	0.262	0.309	0.369	0.512
0.90	0.48		0.031	0.058	0.089	0.121	0.155	0.192	0.234	0.281	0.341	0.484

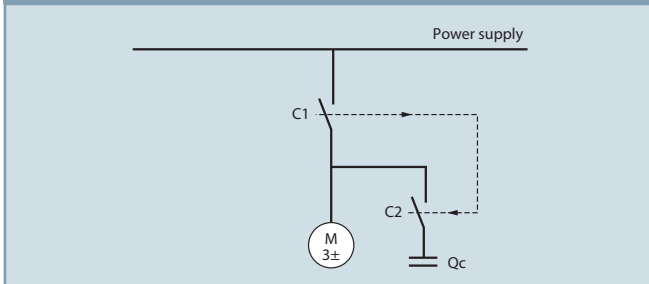
Example: 200 kW motor - $\cos \varphi = 0.75$ - required $\cos \varphi = 0.93$ - $Q_c = 200 \times 0.487 = 98$ kVAr

REACTIVE COMPENSATION OF ASYNCHRONOUS MOTORS (COMPENSATION AT MOTOR TERMINALS)

If $Q_c \leq 90\% I_o \sqrt{3} U$



If $Q_c > 90\% I_o \sqrt{3} U$



I_o : motor off-load current
 U : supply voltage

The table below gives, for information purposes only, the maximum power of the capacitor that can be connected **directly to the terminals of an asynchronous motor with no risk of self-excitation**. It will be necessary to check in all cases that the maximum current of the capacitor does not exceed 90% of the magnetising current (off-load) of the motor.

Maximum power of the motor		Maximum speed rpm		
		3000	1500	1000
HP	kW	Max. power in kVAr		
11	8	2	2	3
15	11	3	4	5
20	15	4	5	6
25	18	5	7	7.5
30	22	6	8	9
40	30	7.5	10	11
50	37	9	11	12.5
60	45	11	13	14
100	75	17	22	25
150	110	24	29	33
180	132	31	36	38
218	160	35	41	44
274	200	43	47	53
340	250	52	57	63
380	280	57	63	70
482	355	67	76	86

If the capacitor power required to compensate the motor is greater than the values given in the above table or if, more generally: $Q_c > 90\% I_o \sqrt{3} U$, compensation at the motor terminals will however remain possible by inserting a contactor (C.2), controlled by an auxiliary contact of the motor contactor (C.1), in series with the capacitor.

How to calculate the power of capacitors (continued)

REACTIVE COMPENSATION OF TRANSFORMERS



When defining a reactive energy compensation installation, it is advisable to provide a fixed capacitor corresponding to the internal reactive consumption of the transformer at 75% load.

In order to operate correctly, a transformer requires internal reactive energy to magnetise its windings. The table opposite gives, for information purposes only, the value of the fixed capacitor bank to be installed according to the powers and loads of the transformer. These values may change, depending on the technology of the device. Each manufacturer can provide their own precise values.

Nominal power of the transformer kVA	KVAr power to be provided for the internal consumption of the transformer		
	Operation		
	off-load	75% load	100% load
100	3	5	6
160	4	7.5	10
200	4	9	12
250	5	11	15
315	6	15	20
400	8	20	25
500	10	25	30
630	12	30	40
800	20	40	55
1000	25	50	70
1250	30	70	90
2000	50	100	150
2500	60	150	200
3150	90	200	250
4000	160	250	320
5000	200	300	425