Epic Power Converters, S.L.
CIF: B99349623

Calle F Oeste Nave 93, G. Quejido - 50016 Zaragoza (Spain)
info@epicpower.es - www.epicpower.es

Author
R.Ramón
support@epicpower.es

AN022
This application note shows the energy savings that can be expected in different type of elevators by installing the Energy Recovery System, ERS2G.

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Application Note - AN022

Energy saving estimations with ERS 2G

Introduction

To evaluate the impact of the installation of the ERS 2G product in a high-traffic elevator an estimation of energy savings is created based on the ISO 25745-2 (*Energy performance of lifts, escalators and moving walks - Part 2: Energy calculation and classification for lifts (elevators)*).

The biggest impact on the energy efficiency of a high-traffic elevator is found in the overall efficiency of the system. This efficiency can be obtained by receiving or measuring each one of the elements efficiency involved in the elevator traction and multiplying each one of them to obtain the overall efficiency of the system, but this method can become long and inaccurate if not all the elements are taken into account.

Another option much faster that shows an estimated overall efficiency can be obtained by directly measuring the power transfer in the motor connections with a specific load. By performing a trip up and down empty or fully loaded the measurements will show the power consumed and generated in the same conditions. The efficiency can be then estimated dividing the nominal generated power with the nominal consumed power.

$$Overall\ efficiency\ (\%) = \xi_{100} = \left(\frac{P_{generated}}{P_{consumed}}\right) * 100$$

Although in datasheets it's possible to find overall efficiencies around 80 % we have measured efficiencies around 65-75 % in real life in elevators with gearless motors. Having a gearless motor is key to deal with efficiencies over 50 %.

In the following pages different cases of load, height and number of trips in elevators are shown for standard overall efficiencies of 70 %.

Estimation of energy savings with 1 unit of ERS 2G – 750 trips/day

Estimation of the energy savings that can be obtained in elevators with 750 trips a day (category 4), speeds of 1, 1.2 and 1.6 m/s and efficiencies of 70 % according the ISO 25745-2 are shown below:

Trips per day	750		Energy saving per ERS 2G (kWh/year) according to ISO 25745-2						
Efficiency	0,7			kWh/year	Maximum travel distance (m)					
Speed	1	m/s			15	20	25	30	35	40
			Maximum cabin load (kg)	300	203	271	338	406	474	541
				375	254	338	423	507	592	676
				450	304	406	507	609	710	812
				525	355	474	592	710	829	947
				600	406	541	676	812	947	1082
				675	457	609	761	913	1065	1218
				750	507	676	846	1015	1184	1353
				825	590	787	984	1181	1377	1574
				900	644	859	1073	1288	1503	1717
				975	698	930	1163	1395	1628	1860
				1050	751	1002	1252	1503	1753	2003
				1125	805	1073	1342	1610	1878	2146
				1200	859	1145	1431	1717	2003	2236
				1275	912	1216	1520	1824	2129	2236
				1350	1010	1346	1683	2020	2236	2236
				1425	1066	1421	1777	2132	2236	2236
				1500	1122	1496	1870	2236	2236	2236
				1575	1178	1571	1964	2236	2236	2236
				1650	1234	1646	2057	2236	2236	2236
				1725	1290	1720	2151	2236	2236	2236
				1800	1346	1795	2236	2236	2236	2236
				1875	1403	1870	2236	2236	2236	2236
				1950	1458	1944	2236	2236	2236	2236
				2025	1471	1956	2236	2236	2236	2236
				2100	1478	1964	2236	2236	2236	2236
				2175	1485	1971	2236	2236	2236	2236
				2250	1491	1977	2236	2236	2236	2236
				2325	1497	1983	2236	2236	2236	2236
				2400	1503	1989	2236	2236	2236	2236
				2475	1508	1994	2236	2236	2236	2236
				2550	1513	1999	2236	2236	2236	2236
				2625	1518	2004	2236	2236	2236	2236

Fig. 1: Energy savings per year for average trips according to ISO 25745-2. (1 m/s, 70 % efficiency, 750 trips/day)

Trips per day	750		Energy saving per ERS 2G (kWh/year) according to ISO 25745-2							
Efficiency	0,7			kWh/year	Maximum travel distance (m)					
Speed	1,2	m/s			15	20	25	30	35	40
			Maximum cabin load (kg)	300	203	271	338	406	474	541
				375	254	338	423	507	592	676
				450	304	406	507	609	710	812
				525	355	474	592	710	829	947
				600	406	541	676	812	947	1082
				675	457	609	761	913	1065	1218
				750	507	676	846	1015	1184	1353
				825	590	787	984	1181	1377	1574
				900	644	859	1073	1288	1503	1717
				975	698	930	1163	1395	1628	1860
				1050	751	1002	1252	1503	1753	2003
				1125	805	1073	1342	1610	1878	2146
				1200	859	1145	1431	1717	2003	2236
				1275	912	1216	1520	1824	2129	2236
				1350	1010	1346	1683	2020	2236	2236
				1425	1066	1421	1777	2132	2236	2236
				1500	1122	1496	1870	2236	2236	2236
				1575	1178	1571	1964	2236	2236	2236
				1650	1219	1624	2029	2236	2236	2236
				1725	1230	1635	2040	2236	2236	2236
				1800	1241	1645	2050	2236	2236	2236
				1875	1250	1655	2060	2236	2236	2236
				1950	1259	1664	2069	2236	2236	2236
				2025	1272	1677	2082	2236	2236	2236
				2100	1279	1684	2089	2236	2236	2236
				2175	1286	1691	2096	2236	2236	2236
				2250	1293	1698	2102	2236	2236	2236
				2325	1299	1704	2108	2236	2236	2236
				2400	1304	1709	2114	2236	2236	2236
				2475	1310	1715	2119	2236	2236	2236
				2550	1315	1720	2124	2236	2236	2236
				2625	1319	1724	2129	2236	2236	2236

Fig. 2: Energy savings per year for average trips according to ISO 25745-2. (1.2 m/s, 70 % efficiency, 750 trips/day)

Trips per day	750		Energy saving per ERS 2G (kWh/year) according to ISO 25745-2							
Efficiency	0,7			kWh/year	Maximum travel distance (m)					
Speed	1,6	m/s			15	20	25	30	35	40
			Maximum cabin load (kg)	300	203	271	338	406	474	541
				375	254	338	423	507	592	676
				450	304	406	507	609	710	812
				525	355	474	592	710	829	947
				600	406	541	676	812	947	1082
				675	457	609	761	913	1065	1218
				750	507	676	846	1015	1184	1353
				825	590	787	984	1181	1377	1574
				900	644	859	1073	1288	1503	1717
				975	698	930	1163	1395	1628	1860
				1050	751	1002	1252	1503	1753	2003
				1125	805	1073	1342	1610	1878	2146
				1200	859	1145	1431	1717	2003	2236
				1275	911	1215	1519	1822	2126	2236
				1350	946	1249	1553	1857	2160	2236
				1425	962	1266	1570	1873	2177	2236
				1500	977	1281	1585	1888	2192	2236
				1575	991	1295	1598	1902	2206	2236
				1650	1004	1307	1611	1915	2218	2236
				1725	1015	1319	1622	1926	2230	2236
				1800	1025	1329	1633	1936	2236	2236
				1875	1035	1338	1642	1946	2236	2236
				1950	1044	1347	1651	1955	2236	2236
				2025	1057	1360	1664	1968	2236	2236
				2100	1064	1368	1671	1975	2236	2236
				2175	1071	1375	1678	1982	2236	2236
				2250	1077	1381	1685	1988	2236	2236
				2325	1083	1387	1691	1994	2236	2236
				2400	1089	1393	1696	2000	2236	2236
				2475	1094	1398	1702	2005	2236	2236
				2550	1099	1403	1707	2010	2236	2236
				2625	1104	1408	1711	2015	2236	2236

Fig. 3: Energy savings per year for average trips according to ISO 25745-2. (1.6 m/s, 70 % efficiency, 750 trips/day)

Estimation of energy savings with 1 unit of ERS 2G – 1000 trips/day

Estimation of the energy savings that can be obtained in elevators with 1000 trips a day (category 4), speeds of 1, 1.2 and 1.6 m/s and efficiencies of 70 % according the ISO 25745-2 are shown below:

Trips per day	1000		Energy saving per ERS 2G (kWh/year) according to ISO 25745-2						
Efficiency	0,7			kWh/year	Maximum travel distance (m)					
Speed	1	m/s			15	20	25	30	35	40
			Maximum cabin load (kg)	300	271	361	451	541	631	722
				375	338	451	564	676	789	902
				450	406	541	676	812	947	1082
				525	474	631	789	947	1105	1263
				600	541	722	902	1082	1263	1443
				675	609	812	1015	1218	1421	1623
				750	676	902	1127	1353	1578	1804
				825	787	1049	1312	1574	1836	2099
				900	859	1145	1431	1717	2003	2290
				975	930	1240	1550	1860	2170	2480
				1050	1002	1336	1669	2003	2337	2671
				1125	1073	1431	1789	2146	2504	2862
				1200	1145	1526	1908	2290	2671	3053
				1275	1216	1622	2027	2433	2838	3244
				1350	1346	1795	2244	2693	3142	3590
				1425	1421	1895	2369	2842	3316	3790
				1500	1496	1995	2493	2992	3491	3974
				1575	1571	2094	2618	3142	3665	3974
				1650	1646	2194	2743	3291	3840	3974
				1725	1720	2294	2867	3441	3974	3974
				1800	1795	2394	2992	3590	3974	3974
				1875	1870	2493	3117	3740	3974	3974
				1950	1944	2591	3239	3887	3974	3974
				2025	1961	2609	3262	3910	3974	3974
				2100	1971	2619	3275	3923	3974	3974
				2175	1980	2628	3288	3936	3974	3974
				2250	1989	2651	3299	3947	3974	3974
				2325	1997	2662	3310	3958	3974	3974
				2400	2004	2672	3320	3968	3974	3974
				2475	2011	2682	3329	3974	3974	3974
				2550	2018	2690	3338	3974	3974	3974
				2625	2024	2699	3347	3974	3974	3974

Fig. 4: Energy savings per year for average trips according to ISO 25745-2. (1 m/s, 70 % efficiency, 1000 trips/day)

Trips per day	1000		Energy saving per ERS 2G (kWh/year) according to ISO 25745-2							
Efficiency	0,7			kWh/year	Maximum travel distance (m)					
Speed	1,2	m/s			15	20	25	30	35	40
			Maximum cabin load (kg)	300	271	361	451	541	631	722
				375	338	451	564	676	789	902
				450	406	541	676	812	947	1082
				525	474	631	789	947	1105	1263
				600	541	722	902	1082	1263	1443
				675	609	812	1015	1218	1421	1623
				750	676	902	1127	1353	1578	1804
				825	787	1049	1312	1574	1836	2099
				900	859	1145	1431	1717	2003	2290
				975	930	1240	1550	1860	2170	2480
				1050	1002	1336	1669	2003	2337	2671
				1125	1073	1431	1789	2146	2504	2862
				1200	1145	1526	1908	2290	2671	3053
				1275	1216	1622	2027	2433	2838	3244
				1350	1346	1795	2244	2693	3142	3590
				1425	1421	1895	2369	2842	3316	3790
				1500	1496	1995	2493	2992	3491	3974
				1575	1571	2094	2618	3142	3665	3974
				1650	1625	2165	2705	3247	3786	3974
				1725	1640	2180	2720	3267	3807	3974
				1800	1654	2194	2745	3285	3825	3974
				1875	1667	2207	2762	3302	3842	3974
				1950	1679	2218	2778	3318	3858	3974
				2025	1696	2236	2801	3341	3881	3974
				2100	1706	2246	2814	3354	3894	3974
				2175	1715	2255	2826	3366	3906	3974
				2250	1724	2298	2838	3378	3918	3974
				2325	1732	2309	2849	3388	3928	3974
				2400	1739	2319	2859	3398	3938	3974
				2475	1746	2328	2868	3408	3948	3974
				2550	1753	2337	2877	3417	3957	3974
				2625	1759	2346	2885	3425	3965	3974

Fig. 5: Energy savings per year for average trips according to ISO 25745-2. (1.2 m/s, 70 % efficiency, 1000 trips/day)

Trips per day	1000		Energy saving per ERS 2G (kWh/year) according to ISO 25745-2							
Efficiency	0,7			kWh/year	Maximum travel distance (m)					
Speed	1,6	m/s			15	20	25	30	35	40
			Maximum cabin load (kg)	300	271	361	451	541	631	722
				375	338	451	564	676	789	902
				450	406	541	676	812	947	1082
				525	474	631	789	947	1105	1263
				600	541	722	902	1082	1263	1443
				675	609	812	1015	1218	1421	1623
				750	676	902	1127	1353	1578	1804
				825	787	1049	1312	1574	1836	2099
				900	859	1145	1431	1717	2003	2290
				975	930	1240	1550	1860	2170	2480
				1050	1002	1336	1669	2003	2337	2671
				1125	1073	1431	1789	2146	2504	2862
				1200	1145	1526	1908	2290	2671	3053
				1275	1215	1620	2025	2430	2835	3240
				1350	1261	1666	2071	2475	2896	3301
				1425	1283	1688	2093	2498	2925	3330
				1500	1303	1708	2113	2547	2952	3357
				1575	1321	1726	2131	2572	2977	3381
				1650	1338	1743	2148	2594	2999	3404
				1725	1353	1758	2163	2614	3019	3424
				1800	1367	1772	2228	2632	3037	3442
				1875	1380	1785	2245	2649	3054	3459
				1950	1392	1796	2260	2665	3070	3475
				2025	1409	1814	2283	2688	3093	3498
				2100	1419	1823	2296	2701	3106	3511
				2175	1428	1833	2309	2714	3118	3523
				2250	1436	1915	2320	2725	3130	3535
				2325	1444	1926	2331	2736	3141	3545
				2400	1452	1936	2341	2746	3151	3556
				2475	1459	1945	2350	2755	3160	3565
				2550	1466	1954	2359	2764	3169	3574
				2625	1472	1963	2368	2772	3177	3582

Fig. 6: Energy savings per year for average trips according to ISO 25745-2. (1.6 m/s, 70 % efficiency, 1000 trips/day)

Estimation of energy savings with 1 unit of ERS 2G – 1500 trips/day

Estimation of the energy savings that can be obtained in elevators with 1500 trips a day (category 5), speeds of 1, 1.2 and 1.6 m/s and efficiencies of 70 % according the ISO 25745-2 are shown below:

Trips per day	1500		Energy saving per ERS 2G (kWh/year) according to ISO 25745-2						
Efficiency	0,7			kWh/year	Maximum travel distance (m)					
Speed	1	m/s			15	20	25	30	35	40
			Maximum cabin load (kg)	300	263	351	439	527	615	702
				375	329	439	549	659	768	878
				450	395	527	659	790	922	1054
				525	461	615	768	922	1076	1229
				600	527	702	878	1054	1229	1405
				675	593	790	988	1185	1383	1580
				750	659	878	1098	1317	1537	1756
				825	805	1073	1341	1610	1878	2146
				900	878	1171	1463	1756	2049	2341
				975	951	1268	1585	1902	2220	2537
				1050	1024	1366	1707	2049	2390	2732
				1125	1098	1463	1829	2195	2561	2927
				1200	1171	1561	1951	2341	2732	3122
				1275	1244	1659	2073	2488	2902	3317
				1350	1422	1897	2371	2845	3319	3793
				1425	1502	2002	2503	3003	3504	4004
				1500	1581	2107	2634	3161	3688	4215
				1575	1660	2213	2766	3319	3872	4426
				1650	1739	2318	2898	3477	4057	4471
				1725	1818	2424	3029	3635	4241	4471
				1800	1897	2529	3161	3793	4426	4471
				1875	1976	2634	3293	3951	4471	4471
				1950	2055	2740	3425	4109	4471	4471
				2025	2195	2924	3653	4382	4471	4471
				2100	2211	2940	3669	4397	4471	4471
				2175	2225	2954	3683	4412	4471	4471
				2250	2239	2968	3696	4425	4471	4471
				2325	2251	2980	3709	4438	4471	4471
				2400	2263	2992	3721	4449	4471	4471
				2475	2274	3003	3732	4460	4471	4471
				2550	2285	3013	3742	4471	4471	4471
				2625	2294	3023	3752	4471	4471	4471

Fig. 7: Energy savings per year for average trips according to ISO 25745-2. (1 m/s, 70 % efficiency, 1500 trips/day)

Trips per day	1500		Energy saving per ERS 2G (kWh/year) according to ISO 25745-2							
Efficiency	0,7			kWh/year	Maximum travel distance (m)					
Speed	1,2	m/s			15	20	25	30	35	40
			Maximum cabin load (kg)	300	263	351	439	527	615	702
				375	329	439	549	659	768	878
				450	395	527	659	790	922	1054
				525	461	615	768	922	1076	1229
				600	527	702	878	1054	1229	1405
				675	593	790	988	1185	1383	1580
				750	659	878	1098	1317	1537	1756
				825	805	1073	1341	1610	1878	2146
				900	878	1171	1463	1756	2049	2341
				975	951	1268	1585	1902	2220	2537
				1050	1024	1366	1707	2049	2390	2732
				1125	1098	1463	1829	2195	2561	2927
				1200	1171	1561	1951	2341	2732	3122
				1275	1244	1659	2073	2488	2902	3317
				1350	1422	1897	2371	2845	3319	3793
				1425	1502	2002	2503	3003	3504	4004
				1500	1581	2107	2634	3161	3688	4215
				1575	1660	2213	2766	3319	3872	4426
				1650	1739	2318	2898	3477	4057	4471
				1725	1818	2424	3029	3635	4241	4471
				1800	1843	2450	3057	3665	4272	4471
				1875	1863	2471	3078	3685	4292	4471
				1950	1882	2489	3097	3704	4311	4471
				2025	1919	2527	3134	3741	4349	4471
				2100	1935	2542	3150	3757	4364	4471
				2175	1949	2557	3164	3771	4379	4471
				2250	1963	2570	3177	3785	4392	4471
				2325	1975	2583	3190	3797	4405	4471
				2400	1987	2594	3202	3809	4416	4471
				2475	1998	2605	3213	3820	4427	4471
				2550	2008	2616	3223	3830	4438	4471
				2625	2018	2626	3233	3840	4448	4471

Fig. 8: Energy savings per year for average trips according to ISO 25745-2. (1.2 m/s, 70 % efficiency, 1500 trips/day)

Trips per day	1500		Energy saving per ERS 2G (kWh/year) according to ISO 25745-2							
Efficiency	0,7			kWh/year	Maximum travel distance (m)					
Speed	1,6	m/s			15	20	25	30	35	40
			Maximum cabin load (kg)	300	263	351	439	527	615	702
				375	329	439	549	659	768	878
				450	395	527	659	790	922	1054
				525	461	615	768	922	1076	1229
				600	527	702	878	1054	1229	1405
				675	593	790	988	1185	1383	1580
				750	659	878	1098	1317	1537	1756
				825	805	1073	1341	1610	1878	2146
				900	878	1171	1463	1756	2049	2341
				975	951	1268	1585	1902	2220	2537
				1050	1024	1366	1707	2049	2390	2732
				1125	1098	1463	1829	2195	2561	2927
				1200	1171	1561	1951	2341	2732	3122
				1275	1244	1659	2073	2488	2902	3317
				1350	1394	1850	2305	2761	3216	3672
				1425	1430	1886	2341	2797	3252	3707
				1500	1462	1918	2373	2829	3284	3740
				1575	1491	1947	2402	2858	3313	3769
				1650	1518	1973	2429	2884	3340	3795
				1725	1542	1997	2453	2908	3364	3819
				1800	1564	2020	2475	2930	3386	3841
				1875	1584	2040	2495	2951	3406	3862
				1950	1603	2059	2514	2970	3425	3881
				2025	1641	2096	2552	3007	3463	3918
				2100	1656	2112	2567	3023	3478	3934
				2175	1670	2126	2581	3037	3492	3948
				2250	1684	2139	2595	3050	3506	3961
				2325	1696	2152	2607	3063	3518	3974
				2400	1708	2164	2619	3075	3530	3986
				2475	1719	2175	2630	3086	3541	3997
				2550	1730	2185	2641	3096	3552	4007
				2625	1739	2195	2650	3106	3561	4017

Fig. 9: Energy savings per year for average trips according to ISO 25745-2. (1.6 m/s, 70 % efficiency, 1500 trips/day)