

Rotary and Static UPS Technologies

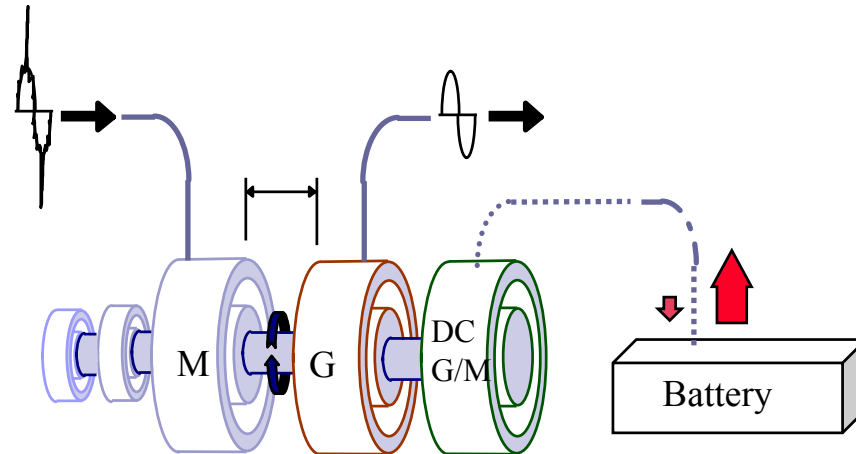
Presented by

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American Power Conversion Corporation

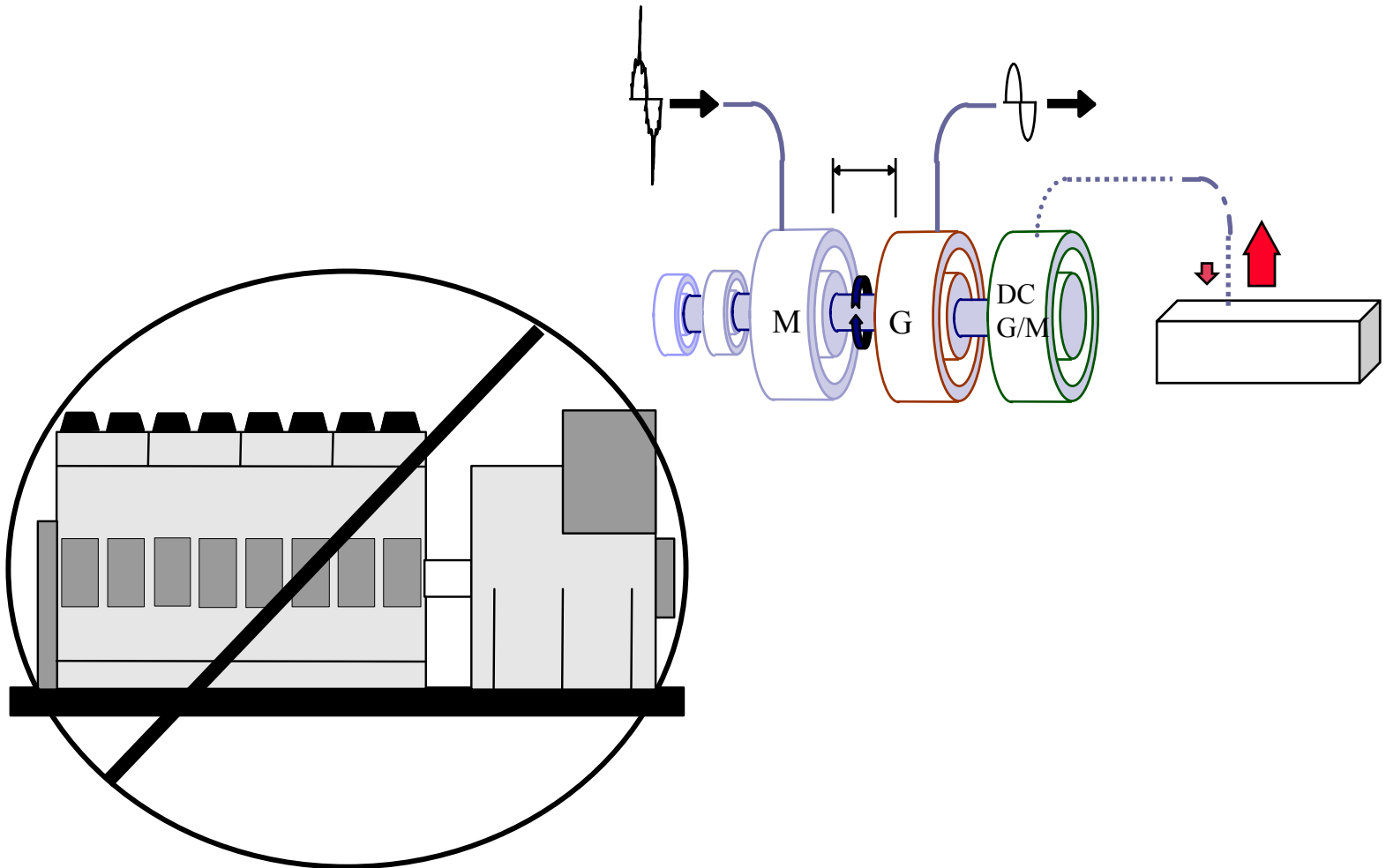
Abstract

The various rotary and static Uninterruptible Power Supply topologies for large applications are presented with their impact on on-site generating facilities. Included are methods and configurations for dealing with distributed generation and engine generator stability.

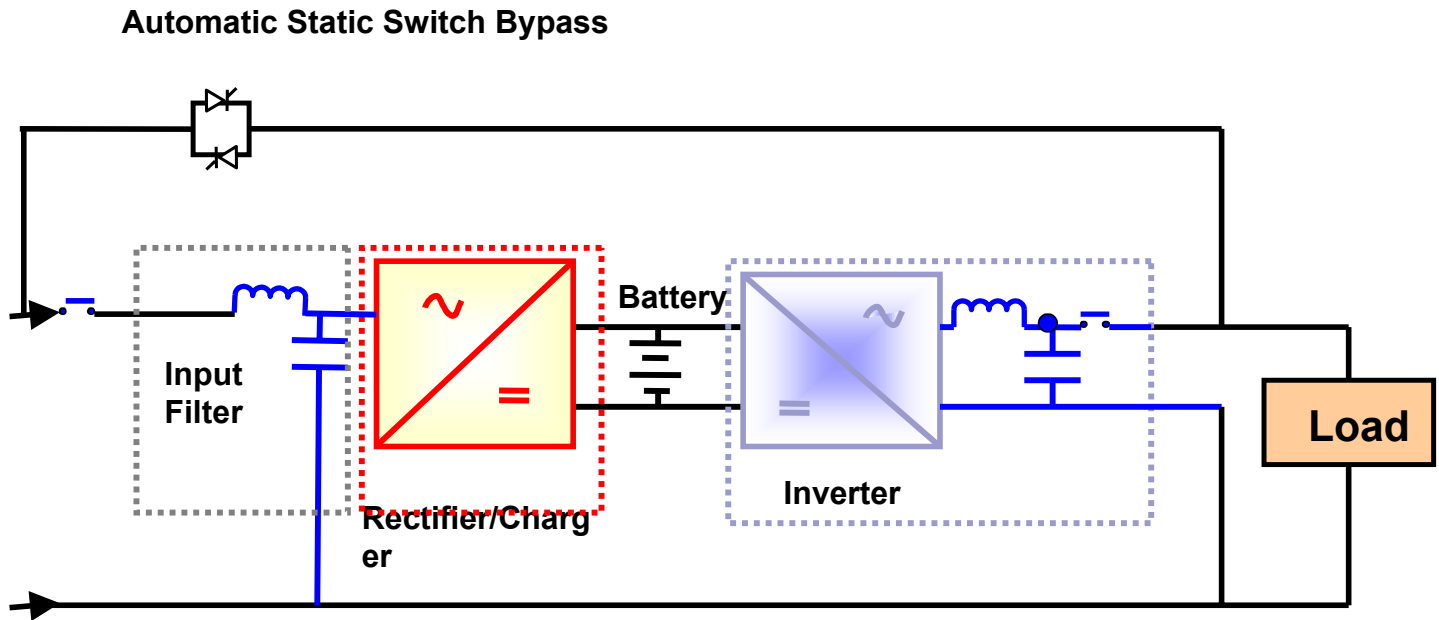
In the beginning there was ROTARY



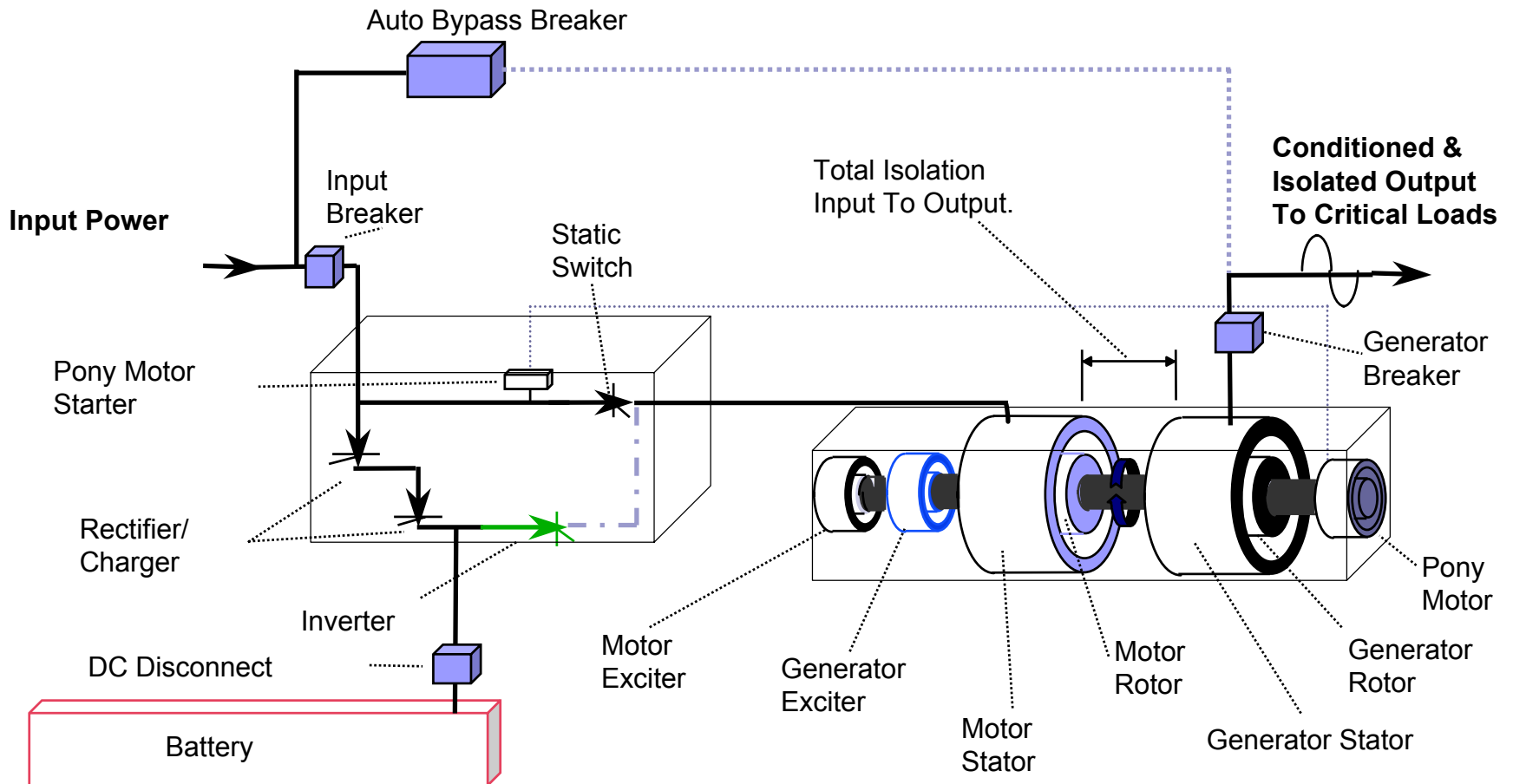
“Incompatible”



Double Conversion UPS

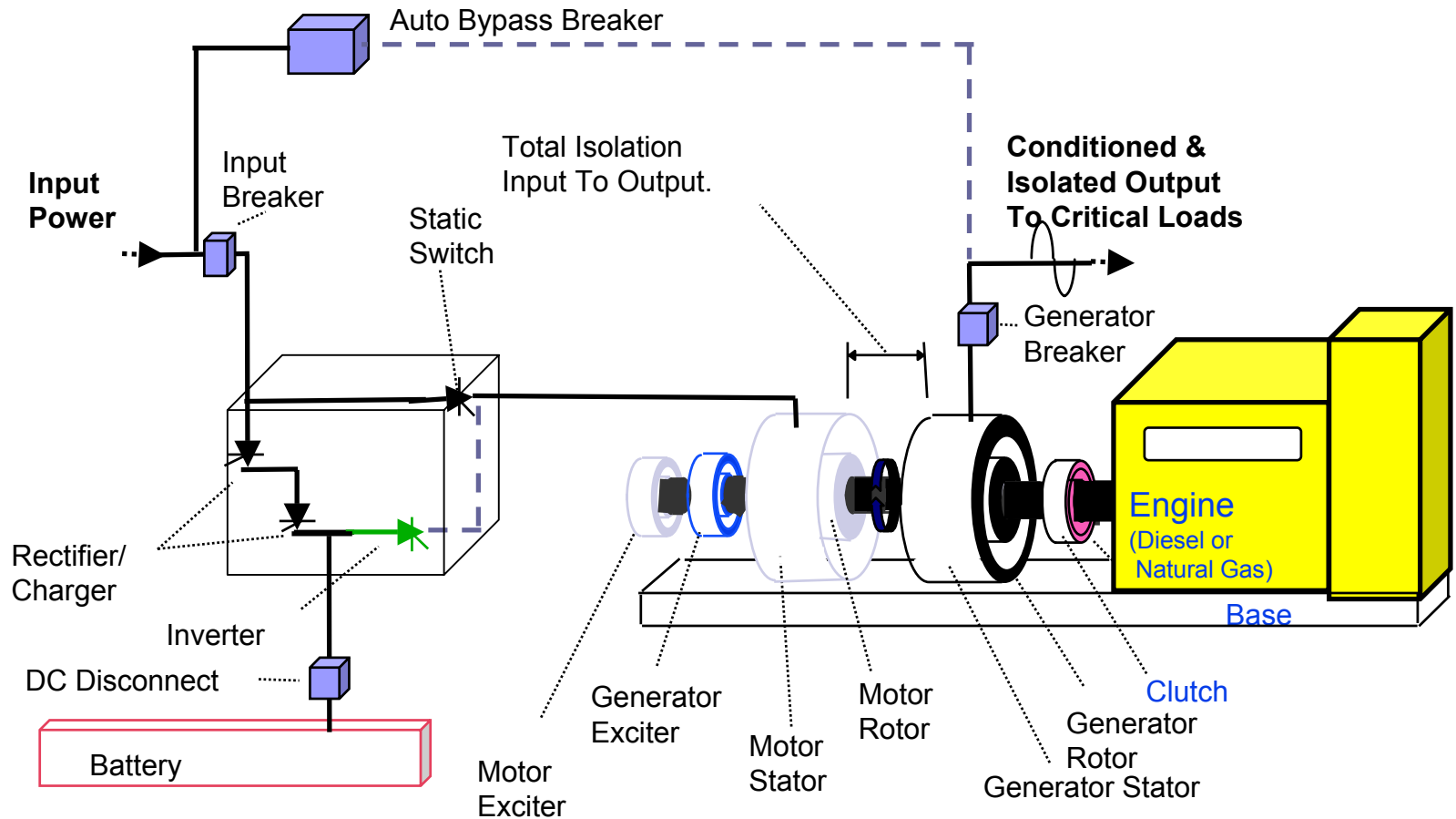


Hybrid Rotary UPS

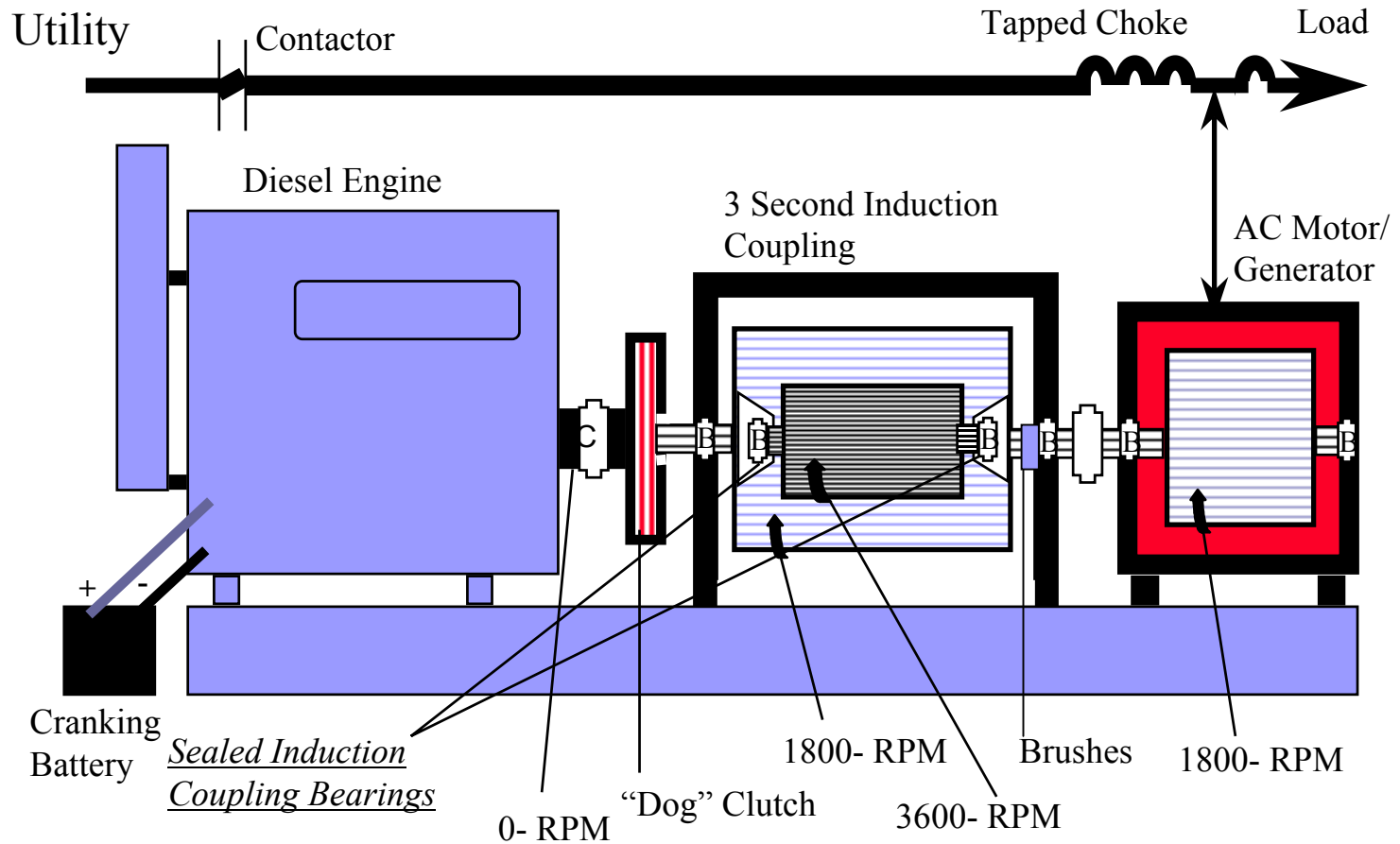


Dual Power Path Rotary UPS

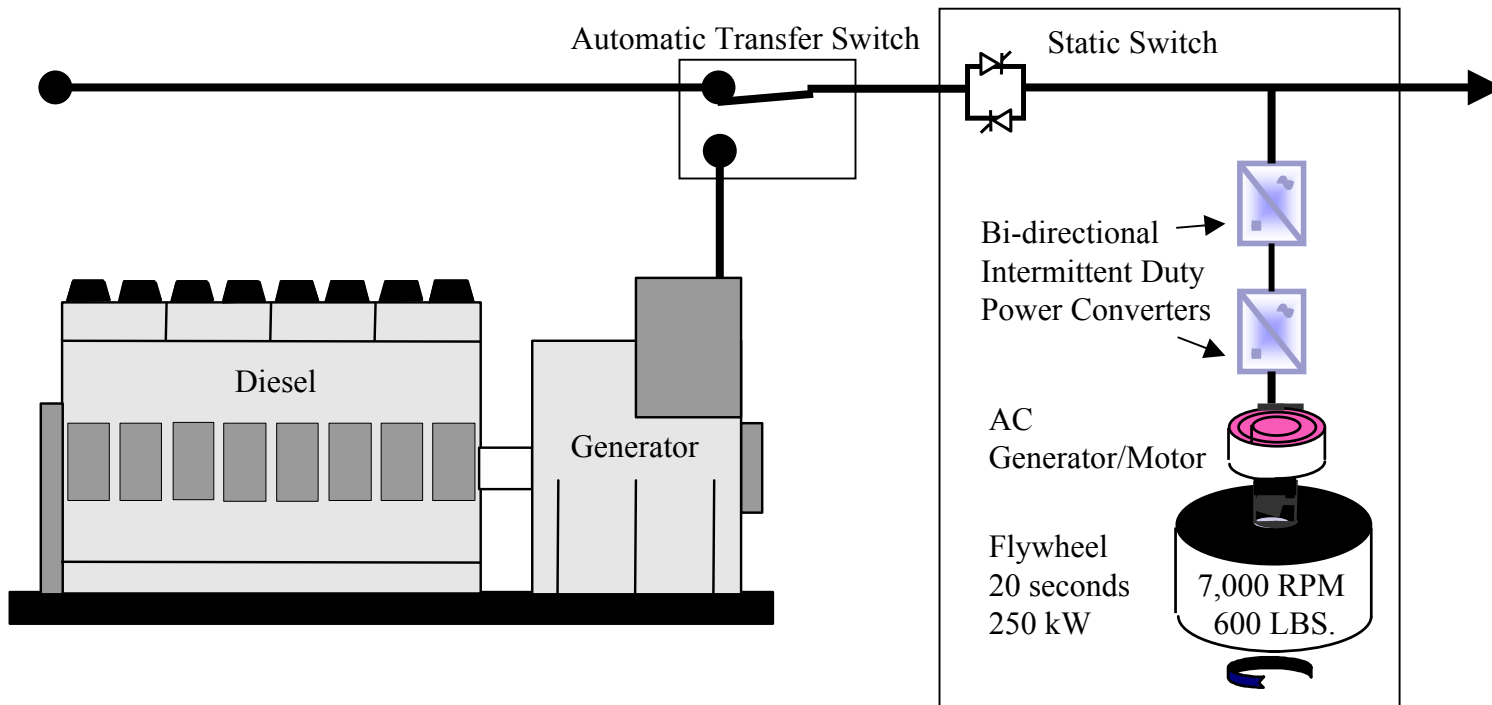
Integral Engine Option



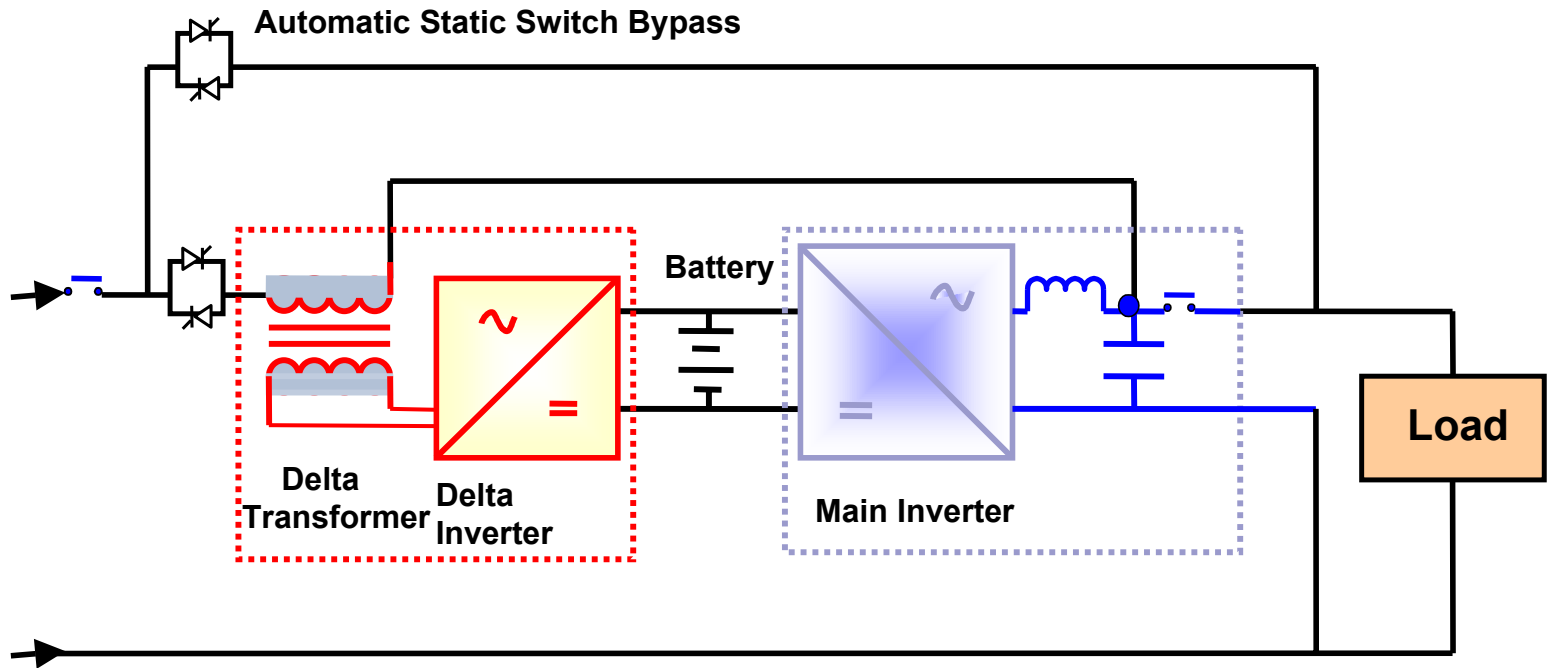
Kinetic Diesel UPS



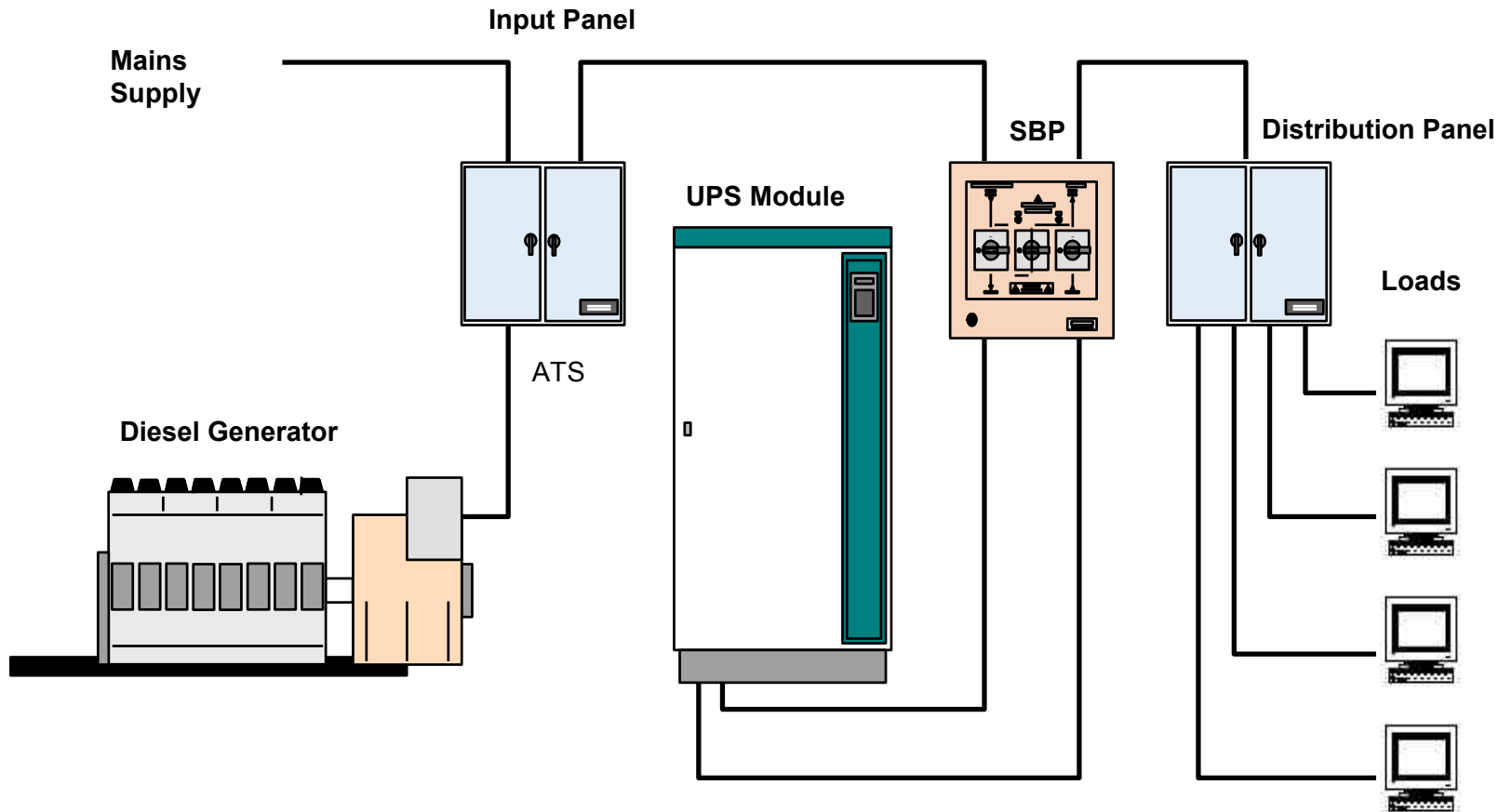
Off-line Flywheel UPS



Delta Conversion UPS



Typical Critical Power System



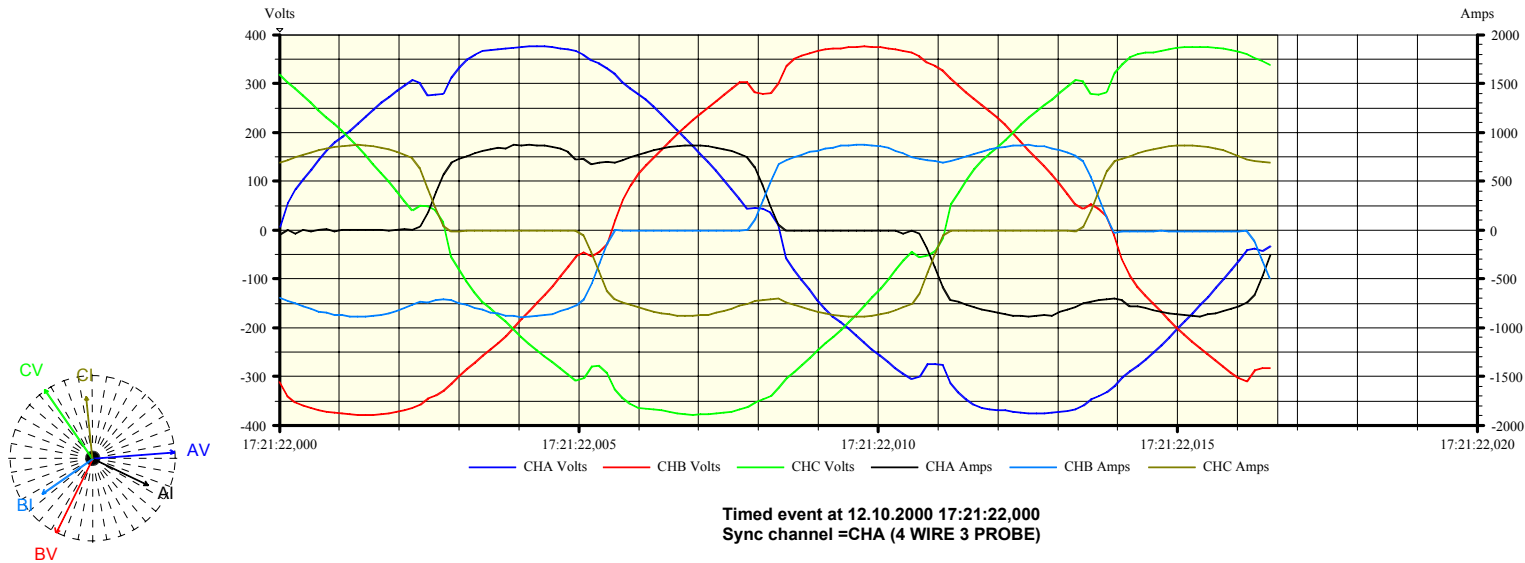
UPS Input Parameters That Impact On-site Power Generation

- **Power Factor**

- **Harmonics**

- **Power Walk-in**

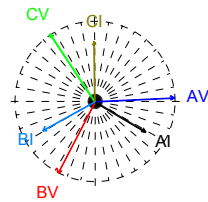
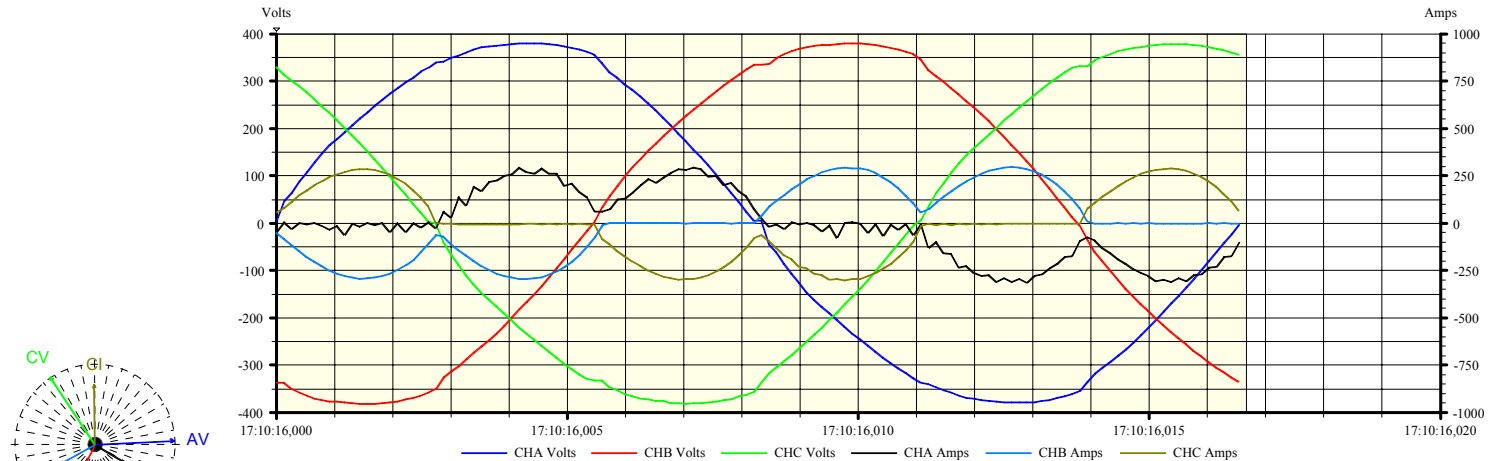
Input of Brand "X" Double Conversion UPS at Full Linear Load



Timed event at 12.10.2000 17:21:22,000
Sync channel =CHA (4 WIRE 3 PROBE)

Unit	A	B	C	D	ABC
V	268.1	269.8	269.0	268.8	269.0
I	645.6	649.4	647.4	0.0	1942.5
kW	144.0	146.4	145.1	0.0	435.5
kVA	173.1	175.2	174.2	0.0	522.5
kVAR	96.0	96.2	96.3	0.0	288.6
PF	0.832	0.836	0.833	0.000	0.834
VTHD	5.87	5.63	5.85	5.95	
ITHD	29.76	29.90	30.17	0.00	
V H3	2.9	2.8	2.4	3.2	
I H3	0.5	0.0	0.3	0.0	
KFact	6.3	6.4	6.5	0.0	
Demand	131.8	134.4	133.1	0.0	399.2 (kW)
Energy	60.1	62.7	62.0	0.0	184.7 (kWh)
ICF	4.3	1.9	1.6	0.0	
HZ	60.0				
Vunbal					0.3

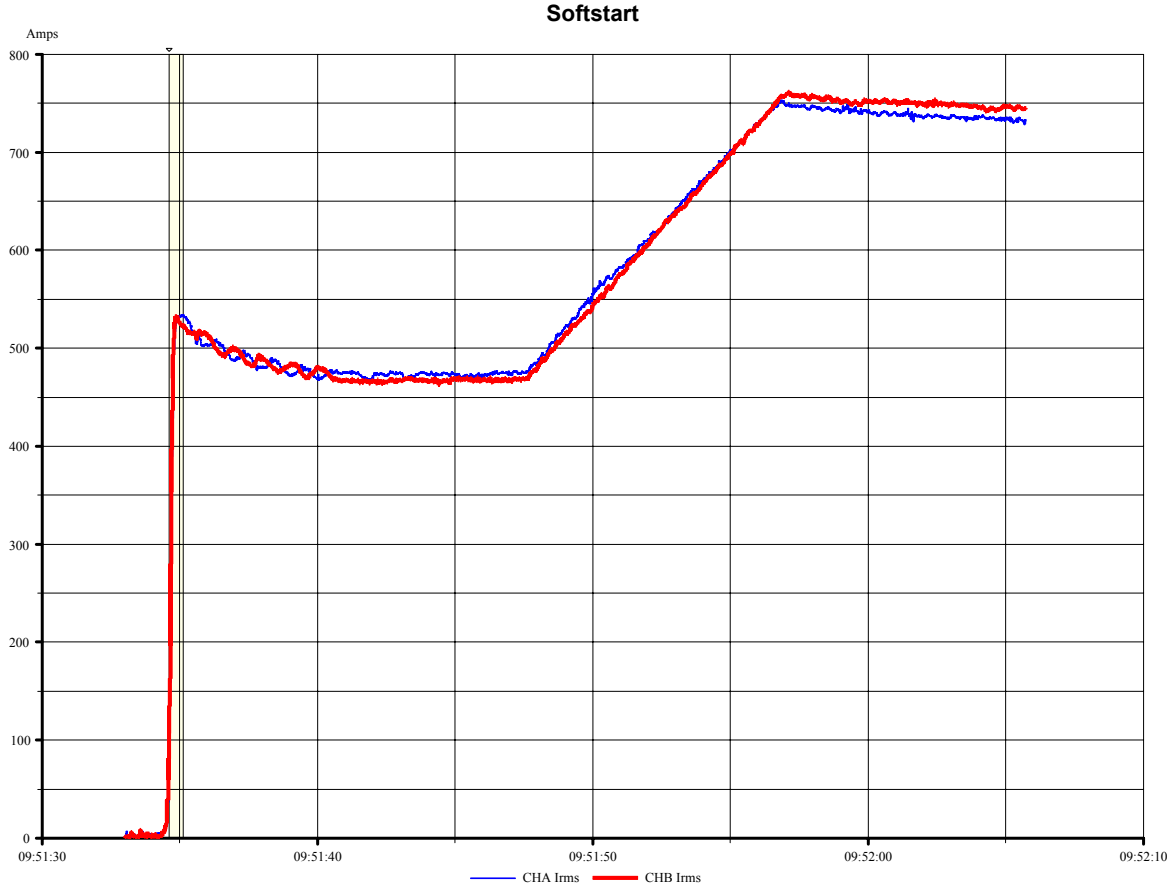
Input of Brand "X" Double Conversion UPS at 25% Linear Load



Timed event at 12.10.2000 17:10:16,000
Sync channel =CHA (4 WIRE 3 PROBE)

Unit	A	B	C	D	ABC
V	275.4	276.0	274.2	275.2	275.2
I	181.1	182.5	181.3	0.0	544.9
kW	37.7	38.2	37.8	0.0	113.7
kVA	49.9	50.4	49.7	0.0	149.9
kVAR	32.6	32.8	32.3	0.0	97.7
PF	0.756	0.759	0.760	0.000	0.758
VTHD	3.63	3.30	3.45	3.24	
ITHD	44.80	44.78	45.17	0.00	
V H3	2.8	2.5	2.8	2.6	
I H3	0.4	0.7	1.3	0.0	
KFact	11.5	8.7	9.3	0.0	
Demand	38.0	38.1	37.7	0.0	113.8 (kW)
Energy	46.3	48.7	48.1	0.0	143.1 (kWh)
ICF	15.0	2.0	2.7	0.0	
HZ	60.0				
Vunbal					0.4

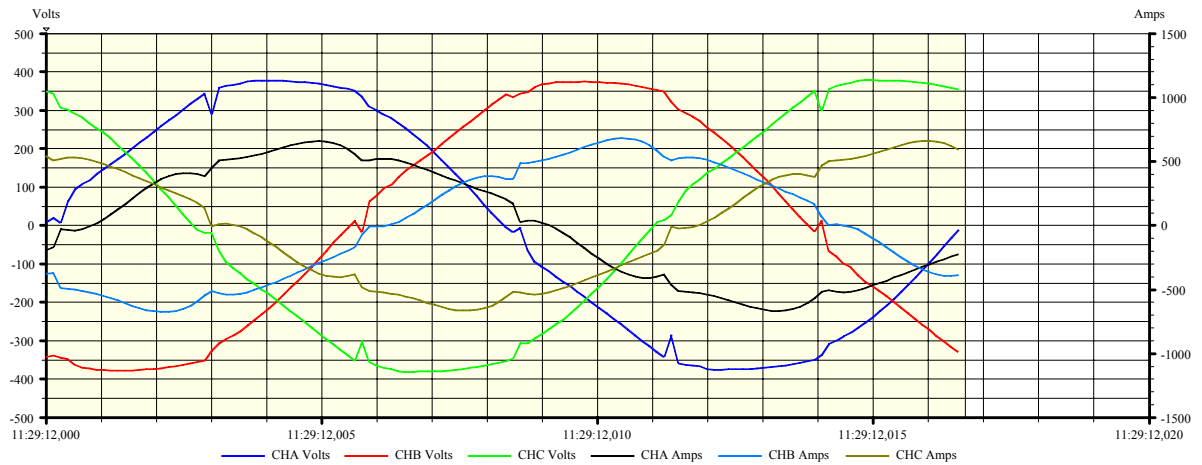
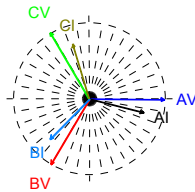
Brand "X" Double Conversion UPS Power Walk-in



	Min	Max	Median
CHA Irms	1.29	753.68	533.01
CHB Irms	0.88	761.41	527.65

13.10.2000 09:51:30,00 - 13.10.2000 09:52:10,00

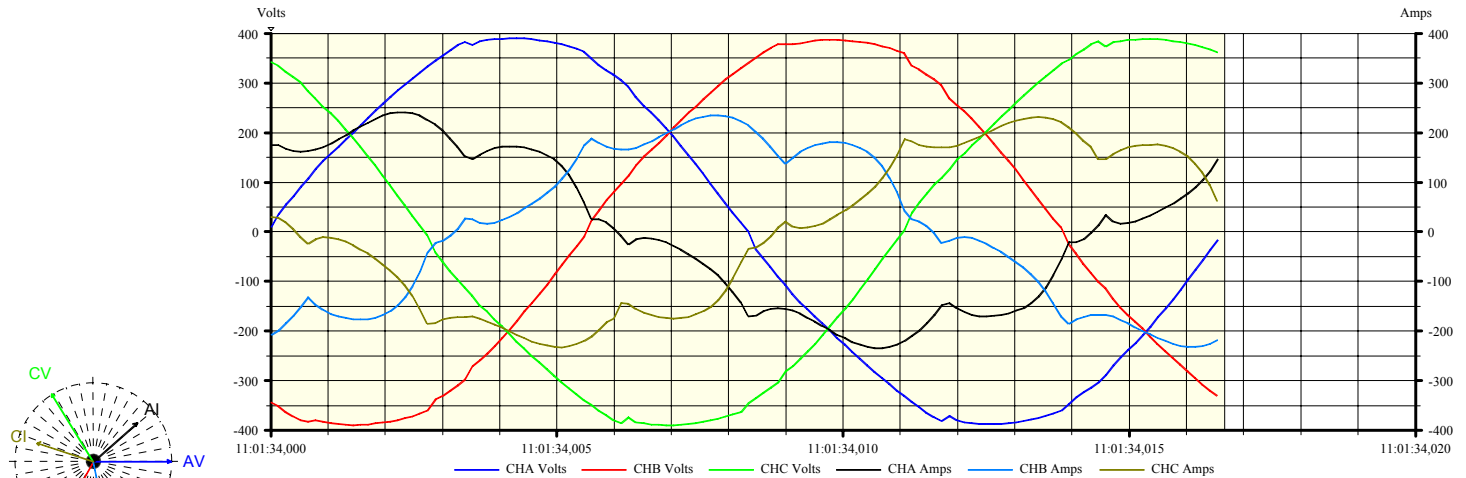
Input of Brand "Y" Double Conversion UPS at 25% Load



Timed event at 13.12.2000 11:29:12,000
Sync channel =CHA (4 WIRE 3 PROBE)

Unit	A	B	C	D	ABC
V	270.8	272.6	274.1	0.7	272.5
I	439.3	441.0	440.0	0.0	1320.4
kW	115.0	116.2	116.6	0.0	347.8
kVA	119.0	120.2	120.6	0.0	359.8
kVAR	30.5	31.0	31.0	0.0	92.4
PF	0.967	0.966	0.966	0.000	0.966
VTHD	3.05	3.53	3.92	0.00	
ITHD	6.99	7.47	6.42	0.00	
V H3	1.9	1.8	2.2	0.0	
I H3	1.6	1.7	0.2	0.0	
KFact	2.0	2.1	1.8	0.0	
Demand	115.0	116.2	116.6	0.0	347.8 (kW)
Energy	511.7	520.4	523.3	0.0	1554.2 (kWh)
ICF	1.5	1.6	1.5	0.0	
HZ	60.0				
Vunbal					0.6

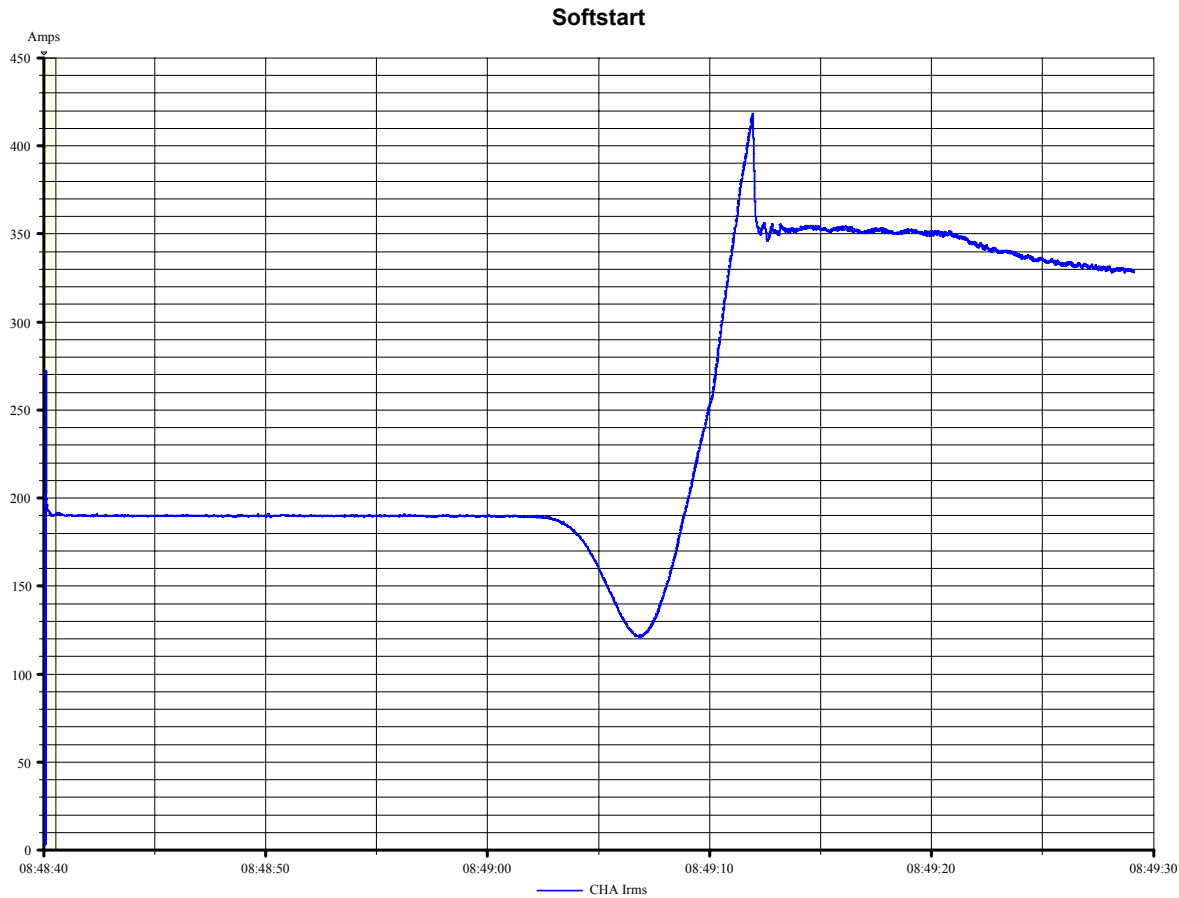
Input of Brand "Y" Double Conversion UPS at Full Linear Load



Timed event at 13.12.2000 11:01:34,000
Sync channel =CHA (4 WIRE 3 PROBE)

Unit	A	B	C	D	ABC
V	279.8	280.0	281.2	0.6	280.3
I	152.7	155.0	154.3	0.0	462.0
kW	31.8	32.3	32.8	0.0	96.9
kVA	42.7	43.4	43.4	0.0	129.5
kVAR	-28.6	-29.0	-28.5	0.0	-86.0
PF	-0.744	-0.745	-0.755	0.000	-0.748
VTHD	2.42	2.51	2.57	0.00	
ITHD	14.39	15.93	14.94	0.00	
V H3	1.8	1.8	1.9	0.0	
I H3	1.8	1.1	1.1	0.0	
KFact	2.6	2.9	2.7	0.0	
Demand	31.8	32.3	32.7	0.0	96.8 (kW)
Energy	479.0	487.4	490.1	0.0	1455.3 (kWh)
ICF	1.6	1.5	2.7	0.0	
HZ	60.0				
Vunbal					0.3

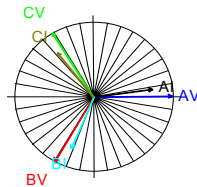
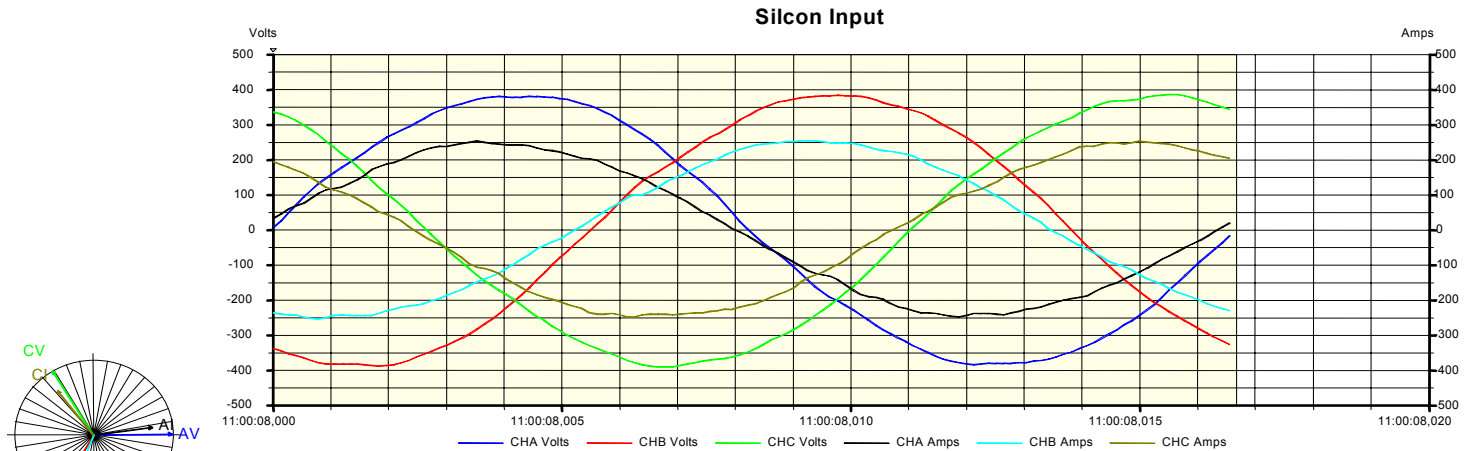
Brand "Y" Double Conversion UPS Power Walk-in



	Min	Max	Median
CHA Irms	3.02	418.73	190.25

15.12.2000 08:48:40,00 - 15.12.2000 08:49:30,00

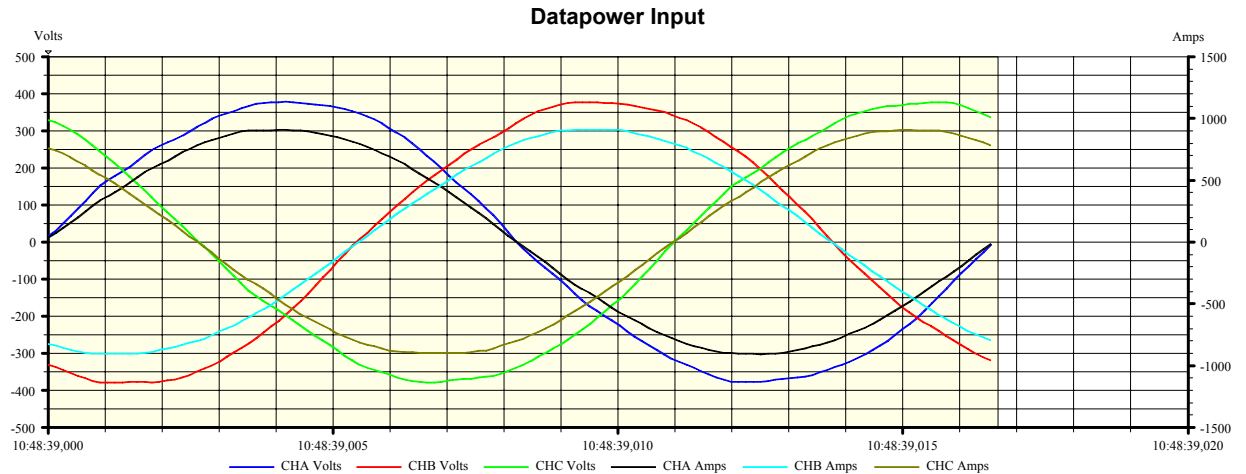
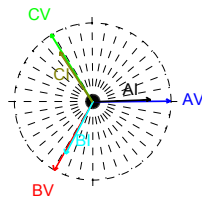
Input of Delta Conversion UPS at 25% Linear Load



Timed event at 12.10.2000 11:00:08,000
Sync channel =CHA (4 WIRE 3 PROBE)

Unit	A	B	C	D	ABC
V	276.2	277.0	275.1	278.5	276.1
I	174.2	178.6	175.9	0.0	528.7
kW	47.7	49.1	48.1	0.0	144.9
kVA	48.1	49.5	48.4	0.0	146.0
KVAR	-6.1	-6.2	-5.4	0.0	-17.7
PF	-0.992	-0.992	-0.994	0.000	-0.993
VTHD	3.13	3.14	3.11	4.12	
ITHD	2.40	2.28	4.77	0.00	
V H3	2.6	2.5	2.4	3.2	
I H3	0.7	0.1	0.6	0.0	
KFact	1.1	1.1	1.1	0.0	
Demand	47.7	49.1	48.1	0.0	144.9 (kW)
Energy	71.3	71.8	75.7	0.0	218.8 (kWh)
ICF	1.5	1.5	1.5	0.0	
HZ	60.0				
Vunbal					0.4

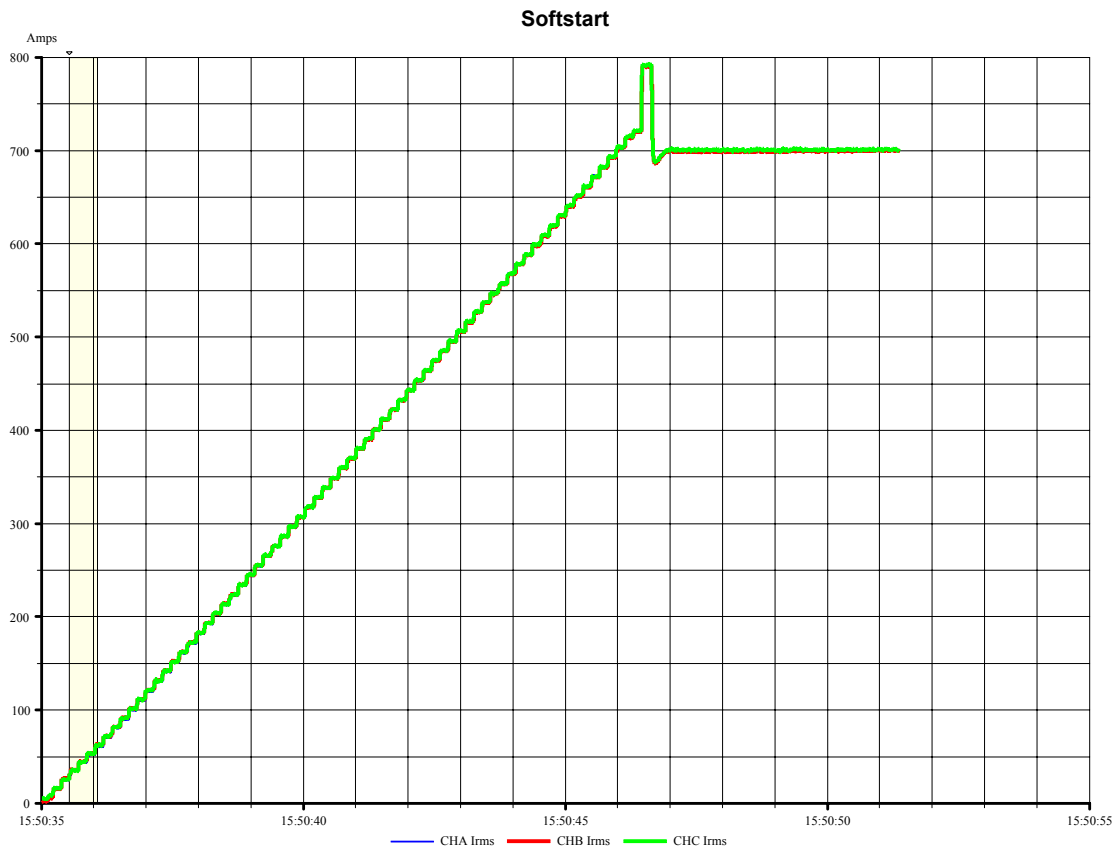
Input of Delta Conversion UPS at Full Linear Load



Timed event at 12.10.2000 10:48:39,000
Sync channel =CHA (4 WIRE 3 PROBE)

Unit	A	B	C	D	ABC
V	271.1	272.8	270.0	276.3	271.3
I	646.1	647.2	646.7	0.0	1940.1
kW	175.0	176.4	174.5	0.0	526.0
kVA	175.2	176.5	174.6	0.0	526.3
kVAR	-6.0	-6.4	-6.4	0.0	-18.8
PF	0.999	0.999	0.999	0.000	0.999
VTHD	2.84	2.85	2.74	3.65	
ITHD	0.66	0.84	1.01	0.00	
V H3	2.6	2.5	2.4	3.4	
I H3	0.0	0.2	0.3	0.0	
KFact	1.0	1.0	1.0	0.0	
Demand	175.1	176.5	174.5	0.0	526.1 (kW)
Energy	47.9	48.1	52.3	0.0	148.3 (kWh)
ICF	1.4	1.4	1.4	0.0	
HZ	60.0				
Vunbal					0.5

Delta Conversion UPS Power Walk-in



	Min	Max	Median
CHA Irms	2.03	792.24	516.96
CHB Irms	1.83	790.89	515.84
CHC Irms	4.21	793.27	517.00

11.10.2000 15:50:35,00 - 11.10.2000 15:50:55,00