

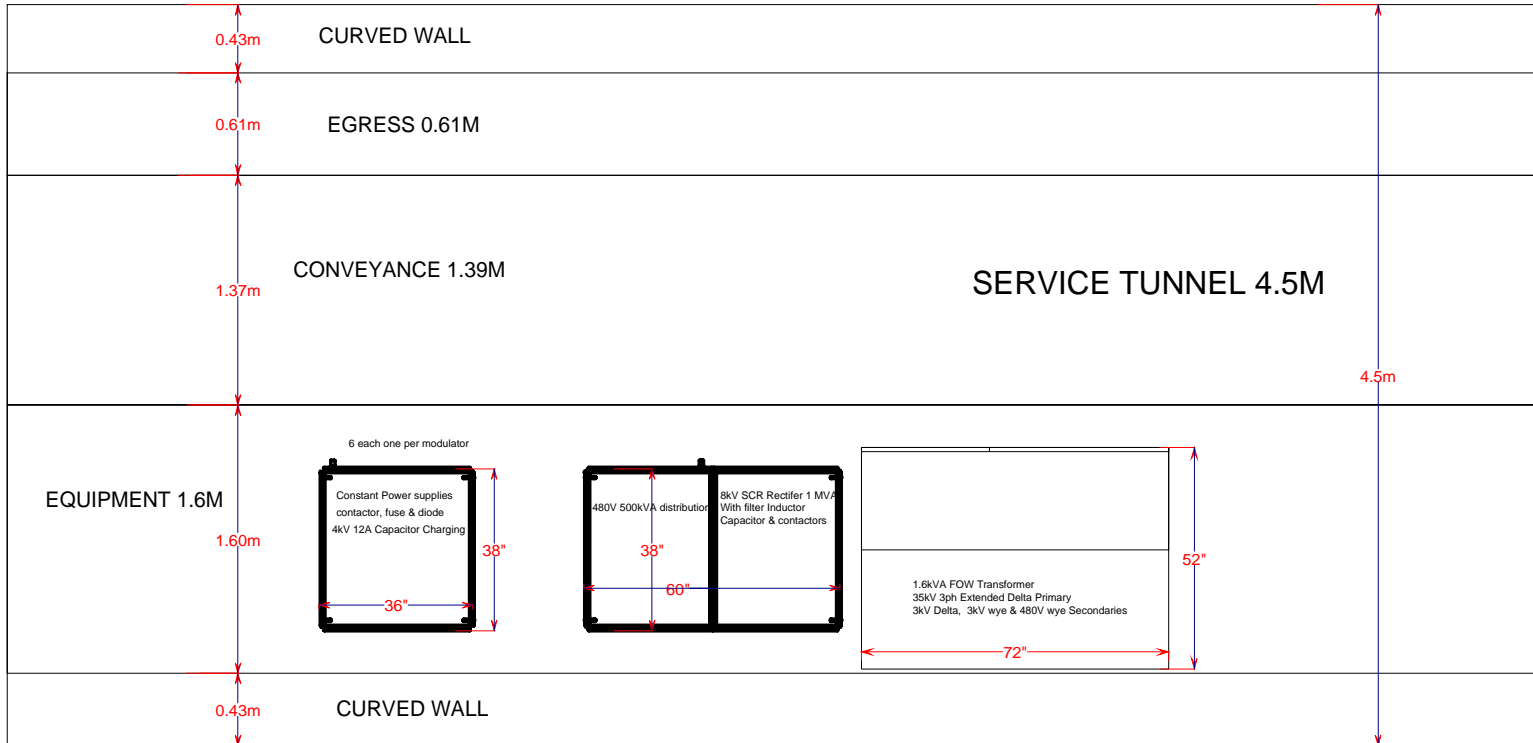
Next Modulators

Next Modulators

8kV DC @ 150A 12 phase
 4kV DC @ 12A Switching supply
 1.5MVA FO water Cooled
 PF>94% pulsed power <5%
 Phase Shifted for 24 phase

Title ILC Modulator Charging Supply		
Size B	Number	Revision
Date: 18 Oct 2006	Sheet of	
File: C:\ADPSCH\ILC\CPS.SCH	Drawn By: R. Giesel	

ILC Modulator Charger tunnel Layout



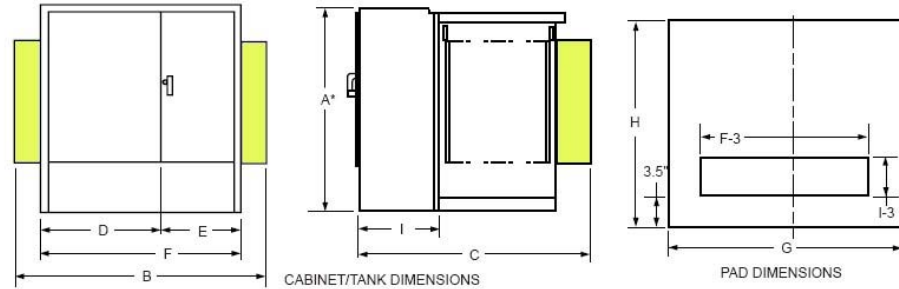
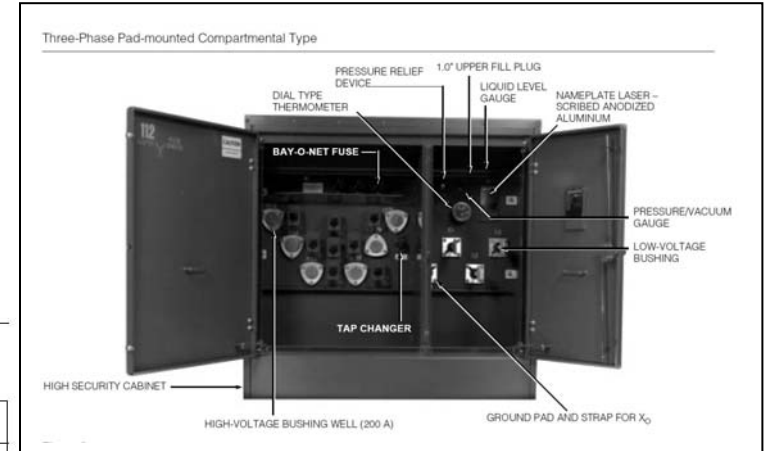


Figure 3. Transformer and Pad dimensions.

* Add 9" for Bay-O-Net fusing.

TABLE 6
Typical Dimensions and Weights³

65°C Rise	DEAD-FRONT - LOOP OR RADIAL FEED - BAY-O-NET FUSING ¹ OIL FILLED -ALUMINUM WINDINGS										Gallons Of Fluid	Approx. Total Weight (lbs.)
	OUTLINE DIMENSIONS (in.)											
kVA Rating	A*	B	C	D	E	F	G	H	I			
45	50	68	39	42	26	68	72	43	20	150	2600	
75	50	68	39	42	26	68	72	43	20	160	2800	
112.5	50	68	49	42	26	68	72	53	20	165	2900	
150	50	68	49	42	26	68	72	53	20	170	3350	
225	50	72	51	42	30	72	76	55	20	180	3800	
300	50	72	51	42	30	72	76	55	20	190	4450	
500 ²	50	89	53	42	30	72	93	57	20	240	5700	
750 ²	64	89	57	42	30	72	93	61	20	380	8200	
1000 ²	64	89	59	42	30	72	93	63	20	480	10,100	
1500 ²	73	89	86	42	30	72	93	90	24	570	13,950	
2000 ²	73	72	87	42	30	72	76	91	24	640	15,000	
2500 ²	73	72	99	42	30	72	76	103	24	760	18,850	
3000 ²	73	84	99	46	37	84	88	103	24	780	19,000	
3750 ²	84	85	108	47	38	85	88	112	24	800	19,500	
5000 ²	84	96	108	48	48	96	100	112	24	930	29,400	
7500 ²	94	102	122	54	48	102	100	126	24	1580	41,900	



Cost of Modulator charging supplies for ILC

Fermi Charger Cost using "Clay Corvin transformer numbers"	\$105,412	per modulator
(First Cut SLAC charger with Transformers	\$67,183	per modulator)
SLAC Charger using "Clay Corvin distribution numbers"	\$78,049	per modulator

Savings minimum

\$27,363 per modulator

Saving total 724 modulators

\$19,810,965 Savings

Cost Bases

Using standard pad 1000kVA transformer using (FOW) Forced oil water cooling rate 1670kVA

Standard 480 Volt Breakers contactors and cables in conduit

Ross single phase Vacuum relays for 8kV DC isolation switches

12kV 20A DC fuses tested for NLC 8-pack project

Diodes cost based on PEP II klystron power supply diode costs

8kV SCR rectifier cost based on PEP II klystron power supply 12kv AC rectifier

Controls cost based on PEP II klystron power supply controls

Using Hoffman Standard Nema 12 steel enclosures to house Supplies and rectifiers

Fermi Charger using Clay Corvin costs

Qty	Item Descriptions	Hours		53			15.0%		Total
				\$US	IL	\$US	\$US	+O&P	
724	1 Liquid-filled dead front transformer, 34.5 kV pri, 277/480 V sec, 3 ph, 225 kVA	36.364	Ea.	12535	1,927.3	247	14,462	\$16,632	\$16,632
4344	6.00 Cable terminations, separable, 34.5 kV insulation dia, .975 to 1.570	1.509	Ea.	183	80.0	0	1,578	\$1,815	\$1,815
5129	7.08 Wire, copper, stranded, 600 volt, #2, type THWN-THHN, in raceway	1.78	CLF	76.5	94.3	0	1,210	\$1,392	\$1,392
724	1.00 Other: EMS, SCADA, RF X-Locks, Hardware	5.25	Lot	715	278.3	0	993	\$1,142	\$1,142
18100	25.00 Wireway, screw cover, 6 x 6, NEMA 1, incl fittings and supports	0.267	L.F	19.1	14.2	0	831	\$956	\$956
1086	1.50 Circuit breakers, 3 pole, 480 V, to 100 amp, for feeder section	2	Ea.	475	106.0	0	872	\$1,002	\$1,002
1368	1.89 Ground wire, copper wire, bare stranded, 4/0	2.807	CLF	178	148.8	0	617	\$710	\$710
22806	31.50 Grounding clamp, bronze, 5/8 diameter	0.25	Ea.	4.2	13.3	0	550	\$632	\$632
1086	1.50 Cable terminations, separable, 34.5 kV insulation dia, .975 to 1.570	1.509	Ea.	183	80.0	0	394	\$454	\$454
363	0.50 Shielded cable copper XLP gounded neutral 35kv 1/0 in RSC	4.706	CLF	410	249.4	0	331	\$380	\$380
14500	20.03 Rigid steel conduit, 2 dia, incl 2 terminations, 2 els, 11 clamps per 100 LF	0.123	L.F	6.4	6.5	0	259	\$298	\$298
SubTotal							Total Transformer cost	\$25,412	
	(SCR power supply Cost per Fermi \$80,000 each 724 units)						Total SCRs Charger cost	\$80,000	
							Total per Modulator	\$105,412	
							\$/Watt	\$0.70	
							Total COST	\$76,318,283	

Transformer and Switching supplies for 6 each 4kV Modulators				\$53.00			15.0%		
Using Clay Corvin Distribution Costs				Material	Labor	Total			
Qty	Item Descriptions	Hours		\$US	US\$ IL	\$US	\$US	" +O&P	Total
6	Hi-Hz Switching PS, Cap. Charge .48kVAC~4kVDC EMI 303 4kV, 50kJ/sec	0.00	Ea.	\$41,000	\$0	\$41,000	\$246,000	\$282,900.00	\$282,900
1	Liquid-filled dead front transformer, 34.5 kV pri, 277/480 V sec, 3 ph, 1000 kVA	50.00	Ea.	24450	\$2,650	\$27,100	\$27,100	\$31,165.00	\$31,165
39	Wire, copper, stranded, 600 volt, 2/0, type THWN-THHN, in raceway	3.64	CLF	226	\$193	\$419	\$16,338	\$18,788.56	\$18,789
700	Rigid steel conduit, 2.5 dia, incl 2 terminations, 2 els, 11 clamps per 100 LF	0.12	L.F	6.4	\$7	\$13	\$9,043	\$10,399.80	\$10,400
6	Other: EMS, SCADA, RF X-Locks, Hardware	5.25	Lot	715	\$278	\$993	\$5,960	\$6,853.43	\$6,853
4	Contactors, 3 pole, 600 volt, 200AF amp, enclosed NEMA 1	4.00	Ea.	900	\$212	\$1,112	\$4,448	\$5,115.20	\$5,115
1	Switchboards, main circuit breaker, 3 pole, 4 wire, 120/208 volt, 225 amp	13.33	Ea.	3105	\$707	\$3,812	\$3,812	\$4,383.40	\$4,383
5	Shielded cable copper XLP gounded neutral 35kv 1/0 in RSC	4.71	CLF	410	\$249	\$659	\$3,297	\$3,791.65	\$3,792
7	Ground wire, copper wire, bare stranded, 4/0	2.81	CLF	230	\$149	\$379	\$2,651	\$3,049.11	\$3,049
1	Circuit breaker, 3 pole, 600 volt, 200AF amp, enclosed NEMA 1	4.00	Ea.	1800	\$212	\$2,012	\$2,012	\$2,313.80	\$2,314
6	Circuit breakers, 3 pole, 240 V, to 60 amp, for feeder section	1.51	Ea.	246	\$80	\$326	\$1,956	\$2,249.24	\$2,249
6	Cable terminations, separable, 34.5 kV insulation dia, .975 to 1.570	1.51	Ea.	183	\$80	\$263	\$1,578	\$1,814.54	\$1,815
24	Grounding clamp, bronze, 5/8 diameter	0.25	Ea.	4.2	\$13	\$17	\$419	\$481.62	\$482
3.6	Wire, copper, stranded, 600 volt, #12, type THWN-THHN, in raceway	0.73	CLF	7.1	\$39	\$46	\$164	\$188.91	\$189
Subtotal						\$78,151 subtotal 6 Modulators			\$373,494
8kV Rectifier and distribution for 6 Modulators									
Qty	Item Descriptions	Hours		\$US	US\$ IL	\$US	\$US	" +O&P	Total
1	8kV 200A SCR rectifier	12.00	Ea.	\$890.00	\$636	\$1,526	\$1,526	\$1,754.90	\$1,755
1	controls	24.00	Ea.	5000	\$1,272	\$6,272	\$6,272	\$7,212.80	\$7,213
1	Enclosure	6.67	Ea.	2100	\$353	\$2,453	\$2,453	\$2,821.35	\$2,821
1	2 phase 80A 12kV vacuum contactors	16.00	Ea.	800	\$848	\$1,648	\$1,648	\$1,895.20	\$1,895
1	8kV capacitor bank 1kJ	18.00	Ea.	600	\$954	\$1,554	\$1,554	\$1,787.10	\$1,787
1	filter inductor	18.00	Ea.	250	\$954	\$1,204	\$1,204	\$1,384.60	\$1,385
6	Electronic rack enclosures, 72 H x 30 W x 36 D	6.67	Ea.	2100	\$353	\$2,453	\$14,720	\$16,928.12	\$16,928
2	80A 12kV vacuum contactors	16.00	Ea.	980	\$848	\$1,828	\$3,656	\$4,204.40	\$4,204
6	80A 12kV vacuum contactors	8.00	Ea.	530	\$424	\$954	\$5,724	\$6,582.60	\$6,583
6	diode 25kV 15A	8.00	Ea.	850	\$424	\$1,274	\$7,644	\$8,790.60	\$8,791
6	15A 12kV DC fuse	8.00	Ea.	98	\$424	\$522	\$3,132	\$3,601.80	\$3,602
5	Shielded cable copper XLP gounded neutral 15kv 1/0 in RSC	4.71	CLF	410	\$249	\$659	\$3,297	\$3,791.65	\$3,792
700	Rigid steel conduit, 2.5 dia, incl 2 terminations, 2 els, 11 clamps per 100 LF	0.12	L.F	6.4	\$7	\$13	\$9,043	\$10,399.80	\$10,400
24	15kv cable terminations	13.33	Ea.	150	\$707	\$857	\$20,560	\$23,643.51	\$23,644
Subtotal						159 Hr labor subtotal 6 Modulators			\$94,798
Total						Total for 6 Modulators			\$468,293
						Total for 724 modulators			\$56,507,318
						cost per modulator			\$78,049
						\$/watt			\$0.52

Using R.Cassel Distribution Costs no overhead and profit

ILC modulator charging supply cost estimate with large transformer 12 phase >94 PF > 95% efficiency				
6	each	3kV 50kW constant power charging supply	\$41,000.00	\$246,000
216	meters	7 each 2/0 cable in 2.5" conduit	\$69.00	\$14,904
2	each	400a breaker shunt trip 480V	\$900.00	\$1,800
2	each	400A contactor 480V	\$730.00	\$1,460
6	each	60A breaker	\$190.00	\$1,140
1	each	Breaker / contactor enclosure	\$200.00	\$200
1	each	Rack	\$1,000.00	\$1,000
6	each	junction box	\$150.00	\$900
18	meters	4 #6 480V cable in 1" conduit	\$14.00	\$252
12	each	8kV 200A SCR rectifier	\$890.00	\$10,680
1	each	controls	\$6,000.00	\$6,000
6	each	diode 25kV 15A	\$850.00	\$5,100
1	each	Enclosure	\$5,000.00	\$5,000
6	each	80A 12kV vacuum contactors	\$800.00	\$4,800
2	each	2 phase 80A 12kV vacuum contactors	\$1,800.00	\$3,600
216	meters	2 each 20A 15kV cable in 1" conduit	\$19.00	\$4,104
24	each	15kv cable terminations	\$85.00	\$2,040
6	each	15A 12kV DC fuse	\$98.00	\$588
1	each	8kV capacitor bank 1kJ	\$600.00	\$600
1	each	filter inductor	\$250.00	\$250
1	each	1.7kVA transformer 35kv/6kV/480V	\$40,100.00	\$40,100
		Extended Delta primary, wye, grounded wye		

total of 6 units **\$350,518**

\$0.15

Cost per modulator

\$67,183