REVISION				
REV.	DESCRIPTION	BY	APPR.	DATE
0	Eng. Rel. Per ECF #41375		JB	7-26-83

SPECIFICATION

HORIZONS RIDE CONTROL SYSTEM

NOV 14 1983

REFERENCE COPY

VOID FOR PRODUCTION

6110-240019 Next Assy	6110-240018 Final Assy	SCALE ---	SHEET SIZE A	DATE	PROJECT HORIZONS RIDE - EPCOT
		◎ CONCENTRICITY / ÷ SYMMETRY / ⌭ MACHINE SURFACE / ⊥ PERPENDICULARITY / ∥ PARALLELISM	UNLESS OTHERWISE SPECIFIED .XX ± .XXX ± ANGLES ± / REMOVE BURRS AND BREAK SHARP EDGES / MACHINED FILLET RADII .015 - .030 / DIMENSION LIMITS HELD AFTER PLATING	DRAWN BY / CHECKED BY / APPROVED 7-26-83 / APPROVED / APPROVED -26-83	DWG TITLE SPECIFICATION HORIZONS RIDE CONTROL SYSTEM — DWG NO. SCDG-151400 6110-151400
NEXT ASSY	FINAL ASSY				
APPLICATION					
MATERIAL	FINISH				SHEET 1 OF 56 — REV 0

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P 2041 R-1

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1.0 INTRODUCTION

The object of this specification is to outline the requirements for the Horizons ride propulsion and control system. The motors and controls will be installed and operate in the Horizons Pavilion at the EPCOT Center, Walt Disney World, Orlando, Florida.

2.0 RIDE DESCRIPTION

The ride utilizes 175 vehicles in a totally linked ride system. Each vehicle accommodates four people. The ride has a normal constant speed of 1.5 ft. per second and is capable of a lower speed of approximately 0.75 ft. per second. The rate of acceleration should be adjustable to achieve full speed in 2 to 20 seconds, with separate accel and decel rates.

Track length is 1346 ft. and rises 31 ft. vertically. The ride utilizes separate "load" and "unload" belt walkways to assist in loading people onto the vehicle. The belt motor controls must follow the vehicle accel/decel rates and velocity. The ride is capable of loading wheelchair-bound riders and thus may be required to stop or run at a relatively low speed, the rate to be determined by WED Operations.

2.1 Environmental Conditions

This ride is a totally enclosed attraction, in a temperature-controlled environment. Equipment must be capable of the following:

Ambient temperature shall not be less than 0° C, or more than 60° C.

Relative humidity to be not less than 30% or more than 80%, non-condensing.

2.2 Storage Conditions

Ambient temperature shall not be less than 0° C, or more than 60° C.

Relative humidity to be not less than 30% or more than 95%, non-condensing.

This equipment may be in storage for a period of nine months, at storage conditions as indicated above.

2.3 Mechanical Summary

Number of Vehicles	=	175
Number of people per vehicle	=	4
Load wt (w/live load)	=	2300 lbs
Coefficient of rolling friction	=	0.05
speed range	=	0 to 1.65 ft./sec.
wheel diameter	=	8 inches
gear ratio	=	25:1
pulley ratio	=	1.3:1

2.4 Propulsion Description

The propulsion system for each vehicle will consist of two motors, one per bogie, which will turn 2 wheels to provide a friction drive on a pipe for an underslung vehicle.

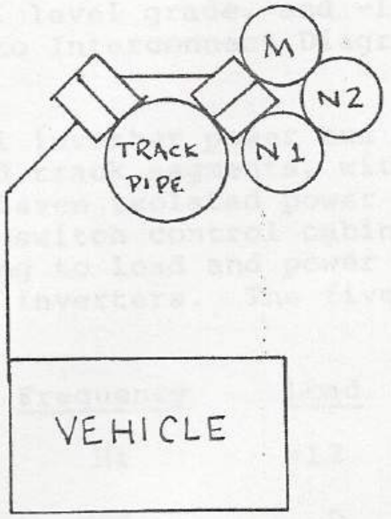


FIGURE 2A - MOTOR DRIVE CONFIGURATION

The ride may be initiated and run from the "load" or "equipment room" consoles. A "Touch Screen" CRT is used as the operator control panel.

The operator may start the ride (after an audible warning spiel) by touching "start" then "LO speed" or "HI speed" on the touchscreen. The command will be executed as a positive acceleration command to the three inverters and the belt walkway DC drives simultaneously.

The inverters provide a constant torque mode speed regulation through a frequency range of 0 to 60 Hz, and constant horsepower control over a frequency range of 60 to 90 Hz.

The control system is provided with 460 to 230 VAC (delta to wye) transformer isolation, to provide 230 VAC to a static AC to DC rectifier. The rectified 300 VDC bus is shared by the 6 pulse width modulated (PWM) inverters (5 active, 1 standby); cabinets share the 300 VDC bus as an integral part of the system.

The 300 VDC bus provides a common power source for all the inverters. This allows a considerable amount of system energy to be regenerated, and thus reduces the overall power required to operate the ride.

The inverters provide 3-phase power to the vehicles through a three-channel slide-rail power bus feed, which provides separate zone control to the ride. Each inverter provides 3-phase power at a specific frequency. The "load" that the ride system represents is divided into three specific loads: +12 degree grade, level grade, and -12 degree grade sections of track (Refer to Interconnect Diagram, Ride Control System, CONT-157861).

The three-channel inverter power bus bar is divided into thirteen isolated track segments, with eleven 100-amp circuit breakers. The eleven isolated power feeds are connected, through the load switch control cabinet, to separate track segments according to load and power requirements, which calls for five 100 KVA inverters. The five inverters are divided as follows:

Inverter	Frequency	Load	Track Sections
PWM 01	Hi	+12	3 (100 AMP CB)
PWM 02	Med	0	2 (100 AMP CB)
PWM 03	Med	0	2 (100 AMP CB)
PWM 04	Med	0	2 (100 AMP CB)
PWM 05	Lo	-12	2 (100 AMP CB)

The objective of the multiple frequency inverter scheme is to provide variable thrust to the three specific load areas: +12 degree lift, 0 degree friction, and -12 degree retard. The optimal result is to reduce the tow bar ± thrust (tension or compression) to zero.

The slide-rail power bus provides 3-phase AC to the two AC induction motors on each vehicle. Each vehicle will have thermal overload and overtemp circuitry to automatically disconnect the vehicle from the power bus if a problem occurs. A green lamp is provided as a visual indication for operations personnel that a vehicle's motor system is operational; an associated infrared LED is also read automatically at the four maintenance stations.

Each inverter is set to a specific frequency in order to provide a specific horsepower in either a "motoring" (power to the motor) or a "regeneration" (power from the motor) mode. This concept of control can provide for "load sharing" with a high-slip type AC motor as long as the wheel size differential is not substantial.

.5 Test Program

This ride system utilizes a test track, at "Tujunga", CA, with several curves and a vertical rise of 10 feet. This test track will be utilized to test mechanical and electrical ride components from November, 1981 to October, 1983.

Ride system testing began in 1981 with a single vehicle, controlled by two isolated bus bar segments, under the control of two VVI (Variable Input/Variable Output) inverters, which provide motoring and retard thrusts to the vehicle.

The second phase of testing begins with the installation of twenty-five vehicles, all linked, to test mechanical components. This phase of testing will be as close to the "real" pavilion ride system as possible. All equipment in the test track area will be enclosed within a tent. Mechanical testing starts about August, 1982, and continues through October, 1983.

In order to support this testing program, an auxiliary power unit will be used to provide 60 Hz, 3-phase power from a continuous bus bar feed throughout the test track circuit. The control equipment listed below will be supplied by the vendor, including a two-step across-line motor starter, sized for twenty-five vehicles.

A. Three phase input circuit breaker - vendor STD for a 50HP system.

B. Three phase output circuit breaker for 50HP system (25 vehicles).

C. Three pole AC starter with 120 VAC contactor coil and start/stop switch.

D. NEMA 1 enclosure for floor mounting of equipment in the present temporary test room.

E. Separate switch box with start-stop switch.

The third phase of testing will demonstrate "complete system" operation and:

A. Establish frequency as a function of load for each zone.

B. Establish three frequencies (all lifts & retards) that are compatible with the optimization of the mechanical system (drawbar tension & compression, car swing, etc.).

C. Test bus bar operation - To allow HP zone changes without arcing or causing inverter load faults due to in-rush currents.

D. Test vehicle braking system for accels and decels.

E. Test vehicle off-board infrared identification system.

The final test track support calls for the installation of three 30 KVA VVI inverters to replace the Pavilion Ride Control Equipment, and allow continued operation with variable speed and variable thrust adjustments.

.6 Noise Spec

All sound generated by motors, gearboxes, contactors, and any mechanical or electrical devices will not exceed a noise criterion value of NC-45 anywhere in the show area. The NC-45 curve is shown on the accompanying sheet. The measurement of this value shall be made in octave bands using an ANSI S1.4-1971 Type 1 Sound Level Meter.

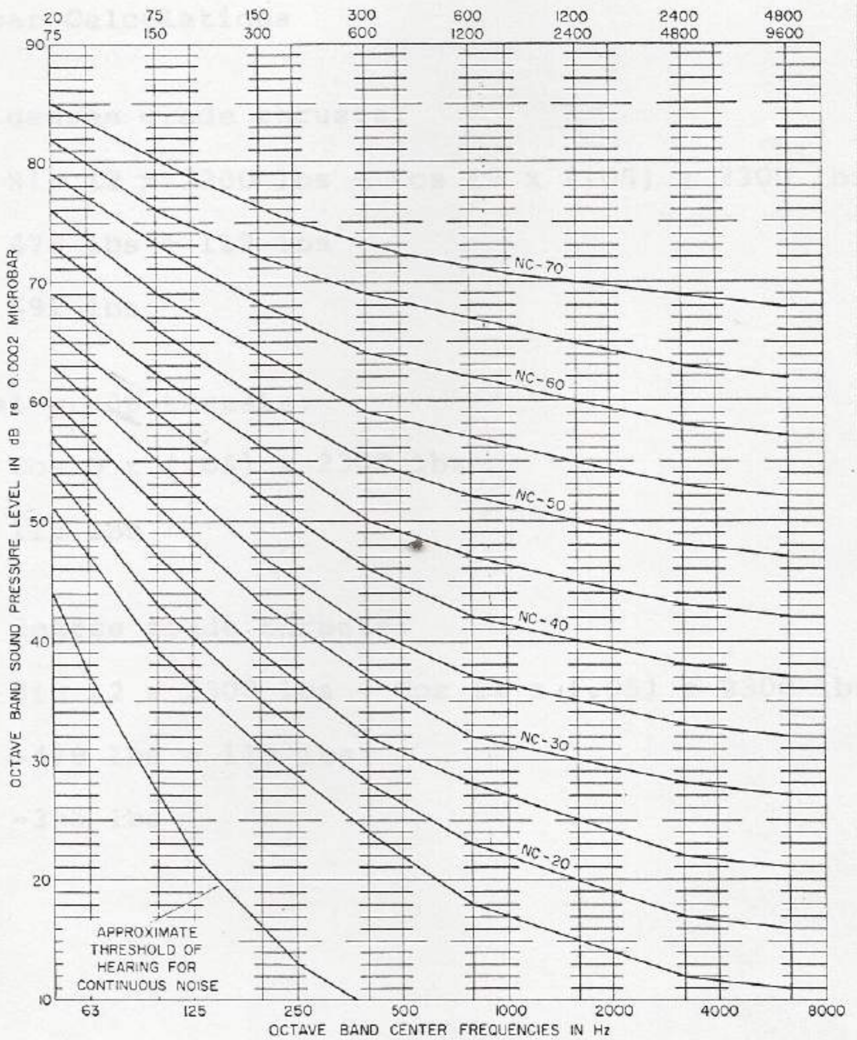


FIGURE 2B - NOISE CRITERIA (NC) CURVES

3.0 RIDE ANALYSIS

3.1 Vehicle Load Calculations

* Mechanical System Parameters

Vehicle Length:	7.75 feet
Vehicle Weight:	2300 lbs (w/live Load)
Rolling Friction:	0.05
Number Of Vehicles:	175
Velocity	0 to 1.65 ft/sec.

* Linear Calculations

+12 degree grade thrusts:

F = Sin 12 x 2300 lbs + Cos 12 x (.05) x 2300 lbs

= 478 lbs + 113 lbs

= 591 lbs

Level grade thrusts:

F = Cos 0 x (.05) x 2300 lbs

= 115 lbs

-12 degree grade thrusts:

F = Sin 12 x 2300 lbs - Cos 12 x (.05) x 2300 lbs

= -478 lbs + 113 lbs

= -365 lbs

.2 Track Profile Calculations

Refer to drawings C3PDX1 Rev. P and C3PDX2 Rev. P, which provide curve and elevation data from the circled reference points on the drawings.

* Track System Parameters

Total Track Length:			1346 feet
Total Grades (not exact)	+12	Grades:	301 feet
	Level	Grades:	755 feet
	-12	Grades:	292 feet

+12 Degree Grades

3 - 9	32
18 - 21	30
23 - 26	37
27 - 30	13
31 - 34	24
37 - 40	23
77 - 87	98
111 - 113	44
Total	301 Feet

$$F = \frac{591 \text{ lbs}}{\text{car}} \times \frac{\text{car}}{7.75 \text{ feet}} \times \frac{301 \text{ feet}}{\text{track}} = 22954 \text{ lbs}$$

$$HP = \frac{22954 \text{ lbs } (1.65 \text{ F/S})}{550\ (.90)} = 76 \text{ HP}$$

22954

0 Degree Grades

113 - 3	172
9 - 18	112
21 - 23	10
26 - 27	10
30 - 31	12
34 - 37	72
40 - 49	134
58 - 63	43
66 - 67	21
74 - 77	40
87 - 91	59
97 - 99	10
102 - 109	60
Total	755 Feet

$$F = \frac{115 \text{ lbs}}{\text{car}} \times \frac{\text{car}}{7.75 \text{ feet}} \times \frac{755 \text{ feet}}{\text{track}} = 11203 \text{ lbs}$$

$$HP = \frac{11203 \text{ lbs } (1.65 \text{ F/S})}{550\ (.90)} = 37 \text{ HP}$$

-12 Degree Grades

109 - 111	43
49 - 58	44
63 - 66	51
67 - 74	74
91 - 97	37
99 - 102	43
Total	292 Feet

$$F = \frac{-365 \text{ lbs}}{\text{car}} \times \frac{\text{car}}{7.75 \text{ feet}} \times \frac{292 \text{ feet}}{\text{track}} = -13752 \text{ lbs}$$

$$HP = \frac{13752 \text{ lbs } (1.65 \text{ F/S})}{550\ (.90)} = -46 \text{ HP}$$

Motor Duty Cycle

+12 Degree Grade

$$= \frac{301 \text{ ft} \times \text{Sec}}{1.5 \text{ ft}} = 201 \text{ Seconds}$$

0 Degree Grade

$$= \frac{754 \text{ ft} \times \text{Sec}}{1.5 \text{ ft}} = 503 \text{ Seconds}$$

-12 Degree Grade

$$= \frac{292 \text{ ft} \times \text{Sec}}{1.5 \text{ ft}} = 195 \text{ Seconds}$$

$$\text{FRMS} = \frac{(F\ {+12} \times t{+12}) + (F\ 0 \times to) + (F{-12} \times T{-12})}{899}$$

$$= \frac{(591 \times 201) + (115 \times 503) + (365 \times 195)}{899}$$

$$= 338 \text{ lbs}$$

$$\text{HP(RMS)} = \frac{338 \text{ lbs} \times 1.5 \text{ F/S}}{550\ (.9)} = 1.02 \text{ HP}$$

4 Control Output Power

(Assume 50% Electrical Losses)

A. +12 Degree Grades Inverter

$$P = 76\ HP \times \frac{760\ Watts}{HP} \times 1.5 = 86.6\ KW$$

B. 0 Degree Grades Inverter

$$P = 37\ HP \times \frac{760\ Watts}{HP} \times 1.5 = 48.0\ KW$$

C. -12 Degree Grades Inverter

$$P = 46\ HP \times \frac{760\ Watts}{HP} \times 1.5 = 60.0\ KW$$

4.0 AC MOTORS AND BRAKES

Two AC induction motors will be required for each vehicle. Each motor will be supplied with a standard rear mount brake (Refer to insert GEM-2576A).

4.1 AC Motor

Model Number	5K48VG8050V
Type	1 HP, 230 VAC, 3-phase, hi-slip (10%), induction motor
Base Speed	1620 RPM @ 10% slip
Ambient Conditions	40° C @ 80% humidity
Duty Cycle	continuous, 17 hours/day
Service Class	I to II
Frame	143T open drip proof (splash guard)
Mounting	foot mount
Shaft	to accept sheave hub for timing belts with tapered hub, capable of mounting hollow shaft standard torque brake on rear of motor
Stator Voltage	vendor's standard-wound stator with klixons set at operating temperature to protect the motor from overtemp
Input	from vendor's PWM inverter output of 230VAC, 60Hz, 3-phase at base speed

4.2 AC Brake

To mount on the rear of the AC motor (Section 4.1).

Torque	3 foot-pounds minimum
Ambient Conditions	40° C @ 80% humidity
Solenoid	230 VAC, 1-phase, 60Hz, controlled from relay outside of motor frame, actuate (brake on) at no voltage
Brake Release	manual release with easy access
Noise	the brake must not chatter in a manual release or normal pick up; final test and determination to be concluded at Tujunga Test Track.

Drive Mechanism

The dual AC motor propulsion unit is mounted on each vehicle as illustrated in Figure 4A.

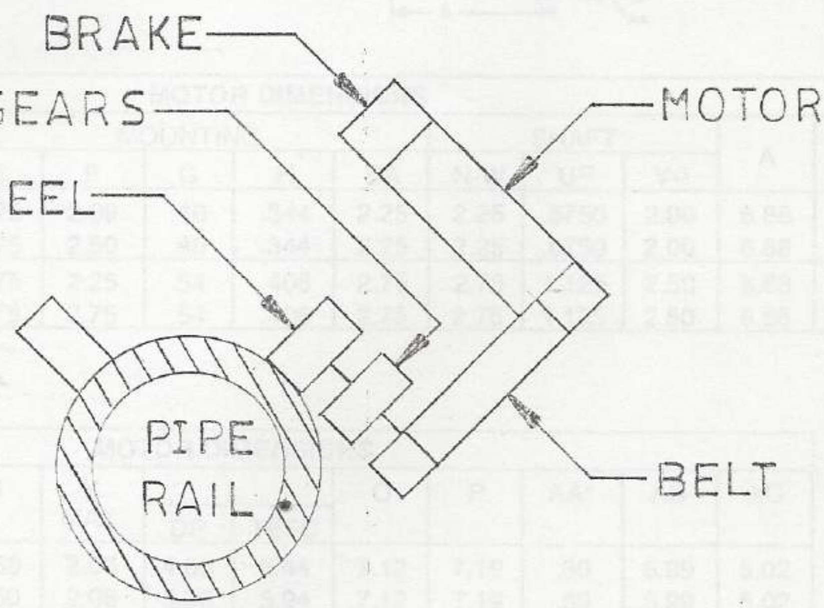
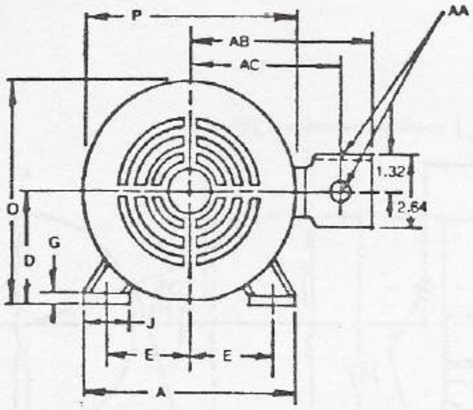
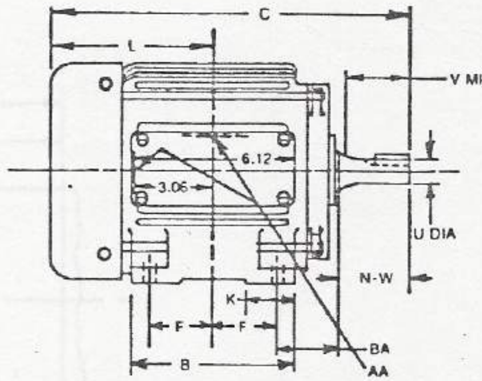


FIGURE 4A - DUAL AC MOTOR UNIT

DIMENSIONS





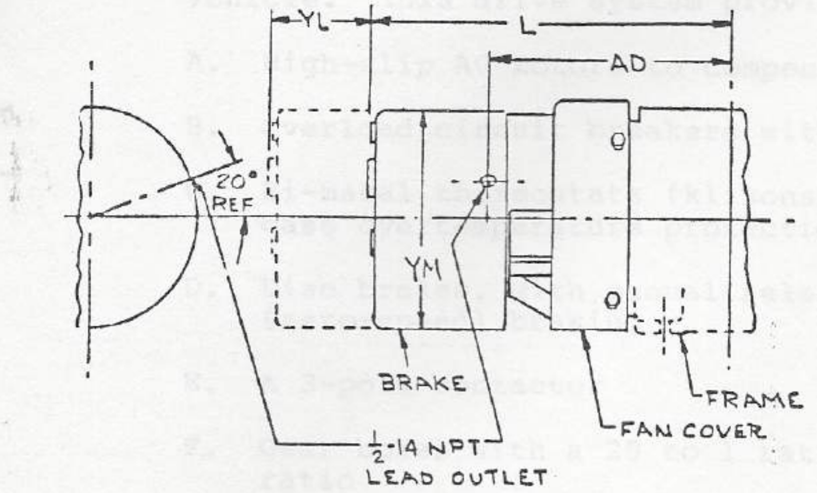
FRAME	MOTOR DIMENSIONS											A	B
	KEY			MOUNTING					SHAFT				
	WIDTH	THK	LG	E	F	G	H	BA	N-W	U□	V△		
143T	.188	.188	1.38	2.75	2.00	.40	.344	2.25	2.25	.8750	2.00	6.88	5.88
145T	.188	.188	1.38	2.75	2.50	.40	.344	2.25	2.25	.8750	2.00	6.88	5.88
182T	.250	.250	1.75	3.75	2.25	.54	.406	2.75	2.75	1.125	2.50	8.68	6.64
184T	.250	.250	1.75	3.75	2.75	.54	.406	2.75	2.75	1.125	2.50	8.68	6.64

FRAME	MOTOR DIMENSIONS											
	C		D‡	J	K MAX.	L		O	P	AA*	AB	AC
	DP	TEFC				DP	TEFC					
143T	11.36	11.94	3.50	1.50	2.06	4.86	5.44	7.12	7.19	.50	5.99	5.02
145T	12.36	12.94	3.50	1.50	2.06	5.36	5.94	7.12	7.19	.50	5.99	5.02
182T	13.58	14.56	4.50	1.60	2.38	5.82	6.80	9.18	9.34	.50	7.03	6.06
184T	14.58	15.56	4.50	1.60	2.38	6.32	7.30	9.18	9.34	.50	7.03	6.06

HP	APPROXIMATE SHIPPING WEIGHT (NOTE)									
	2 POLE				4 POLE		6 POLE		8 POLE	
	DP		TEFC							
	FR	WGT	FR	WGT	FR	WGT	FR	WGT	FR	WGT
¾	143T	23	143T	23	143T	23	143T	31	145T	33
1	143T	23	143T	23	143T	29	145T	29	182T	44
1½	143T	27	143T	27	145T	32	182T	49	184T	54
2	145T	31	145T	31	145T	31	184T	54	—	—
3	145T	31	182T	50	182T	53	—	—	—	—
5	182T	58	184T	60	184T	59	—	—	—	—
7½	184T	64	—	—	—	—	—	—	—	—

NOTE: FOR NET MOTOR WEIGHT SUBTRACT 2 LBS. FOR 140 DIA & 4 LBS. FOR 180 DIA.

□ TOLERANCE +.0000, −.0005
△ STRAIGHT PART OF SHAFT
‡ TOLERANCE +.00, −.03
* HOLE FOR ½ INCH AND KNOCKOUT FOR ¾ CONDUIT



DIMENSIONS ARE MEAN CALCULATED VALUES

P	FRAME	BRAKE	L	AD	YL NOTE 1	YM
1	143T	2-61003-24 2-62006-24	11.33	7.64	3.12	6.81
2	145T	2-61003-24 2-62006-24	11.83	8.14		
3	143T	2-62010-24	11.33	7.64		
4	145T	2-62010-24	11.83	8.14		
5	145T	2-63015-24 2-63020-24	12.01	8.46		
6	143T	2-63015-24 2-63020-24	11.51	7.96		
7	145T	4-61003-30 4-62006-30	12.58	8.26	3.50	6.88
8	143T	4-61003-30 4-62006-30	12.08	7.76		
9	145T	4-62010-30	12.58	8.26		
10	143T	4-63015-30 4-63020-30	12.46	9.14		
11	145T	4-63015-30 4-63020-30	12.96	9.64		
12	143T	4-62010-30	12.08	7.76		

5.0 VEHICLE DRIVE SYSTEM

5.1 Drive System

Figure 5A illustrates the "vehicle drive system" on board each vehicle. This drive system provides the following features:

A. High-slip AC motors to compensate for wheel wear

B. Overload circuit breakers with manual reset

C. Bi-metal thermostats (klixons) in the stators to provide case overtemperature protection

D. Disc brakes, with manual release, to provide static (zero-speed) braking

E. A 3-pole contactor

F. Gear boxes with a 25 to 1 ratio, with a 1.3 to 1 pulley ratio

5.2 Motor Control

Each vehicle utilizes an "on board" motor control box which provides the relay logic control to implement current overload protection, thermal protection, and control logic for the vehicle. Figure 5B illustrates the "control ladder logic" required to provide the following functions:

A. connect proper inverter bus

B. disconnect vehicle motors due to: motor overtemp (K1, L2)
: current overload (OL)
: manual switch (S1)

C. engage motor brakes B1 and B2 through bus bar feed

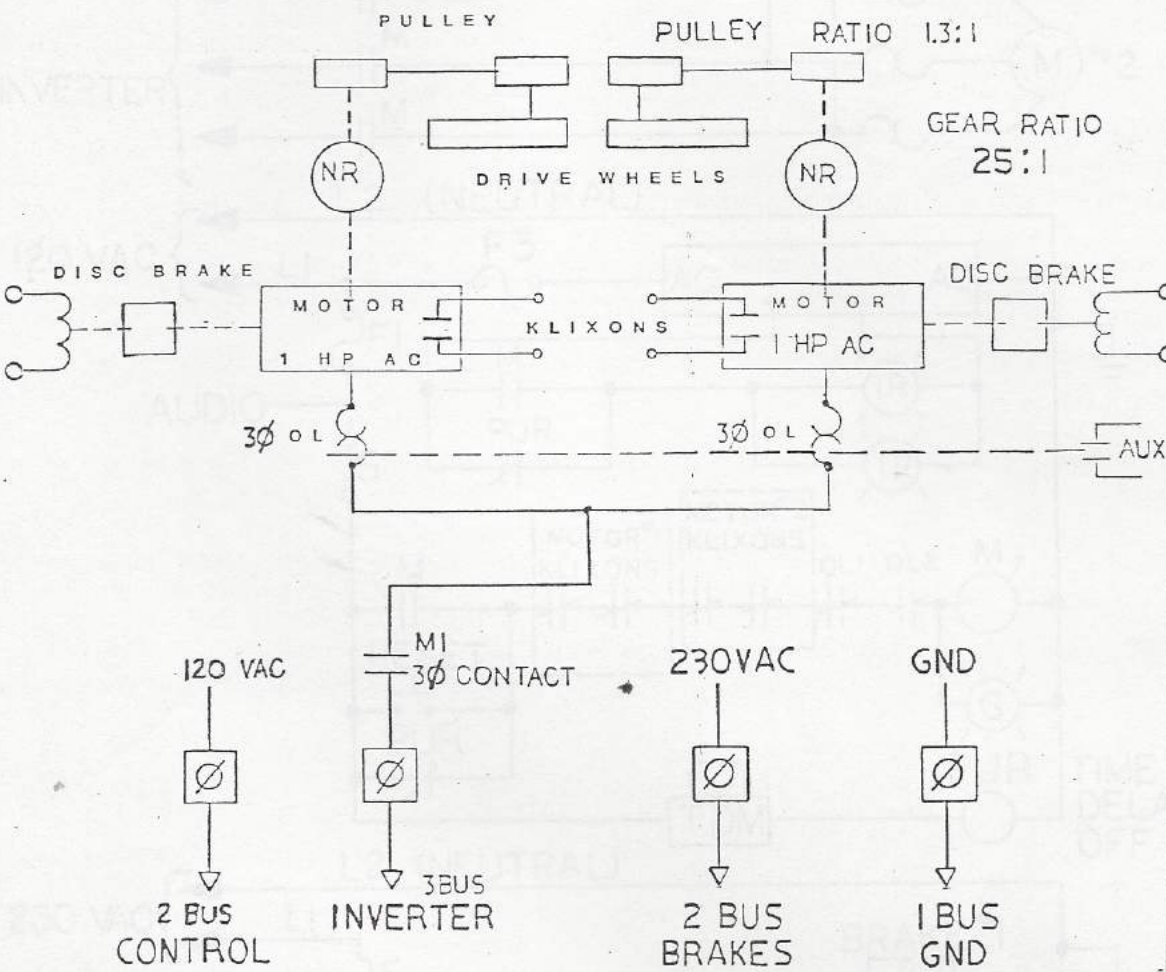


FIGURE 5A - VEHICLE DRIVE SYSTEM

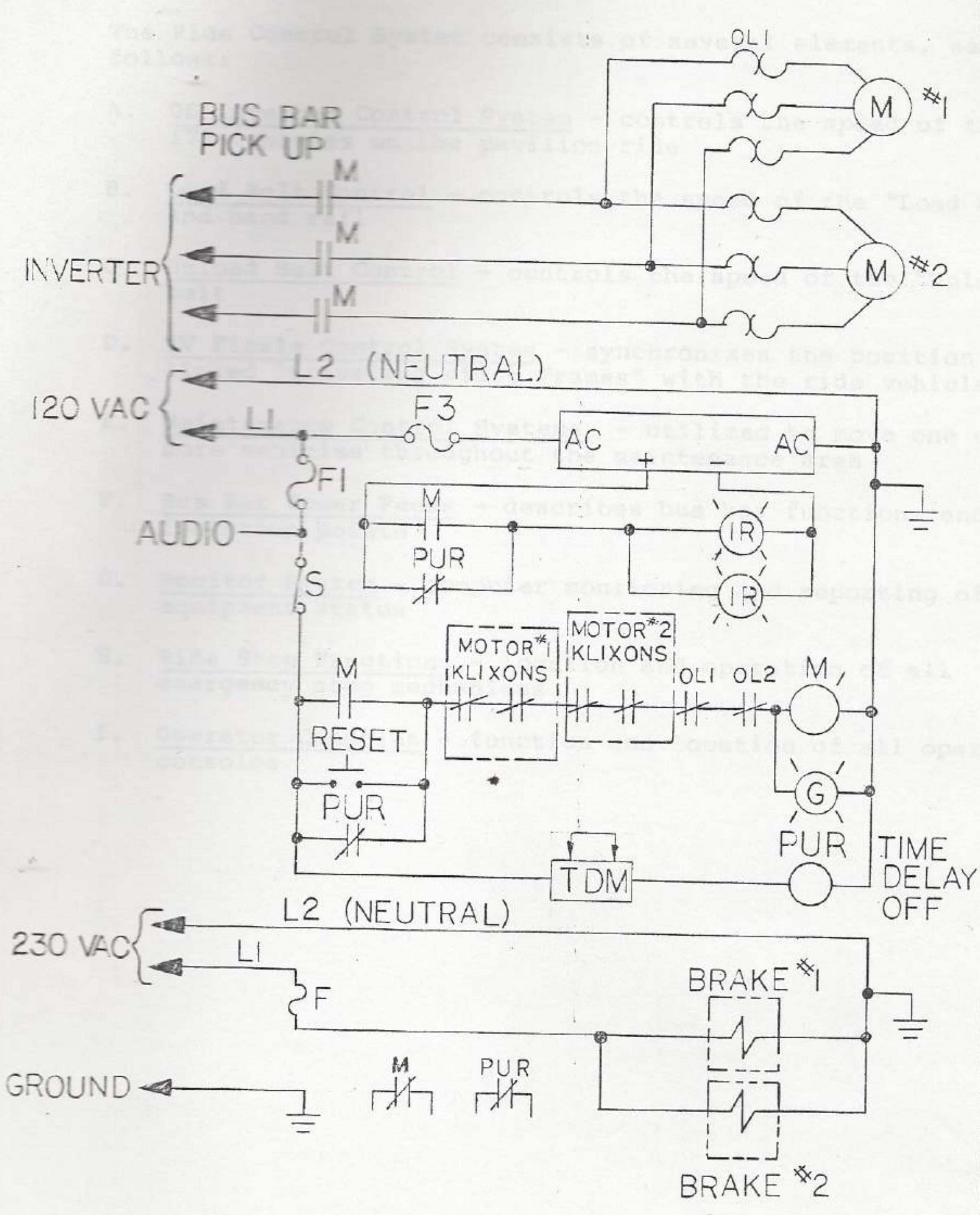


FIGURE 5B - MOTOR BOX WIRING

RIDE CONTROL SYSTEM

The Ride Control System consists of several elements, as follows:

A. GE Inverter Control System - controls the speed of the 175 vehicles on the pavilion ride

B. Load Belt Control - controls the speed of the "Load Belt" and hand rail

C. Unload Belt Control - controls the speed of the "Unload" belt

D. TV Finale Control System - synchronizes the position of linked "traveling video Frames" with the ride vehicles

E. Maintenance Control Systems - utilized to move one or more vehicles throughout the maintenance area

F. Bus Bar Power Feeds - describes bus bar functions and isolation points

G. Monitor System - computer monitoring and reporting of equipment status

H. Ride Stop Functions - location and operation of all emergency stop mechanisms

I. Operator Consoles - function and location of all operator consoles

GE Inverter Control System

Refer to FIGURE 6A, which illustrates the single line control system.

6.1.1 Isolation Transformer

460 to 230 VAC (delta to wye) 3-phase, 500 KVA @ 40° C ambient, with ± 5% taps, in a Nema 1 floor mount enclosure.

6.1.2 Circuit Breaker

Vendor's standard to protect line from xfmr primary.

6.1.3 Static Rectifier

Input Voltage:	230 VAC, 3-phase
Input Frequency:	60 Hz ±3 Hz
Output Voltage:	310 VDC
Output Power:	400 KWDC continuous @ 40° C ambient
Protection:	Door mounted circuit breaker/power disconnect switch - sized to protect xfmr from system faults, and provide total power disconnect for control system
Enclosure:	Nema 1 - double door, floor standing, height not to exceed 90", depth and width - vendor's standard
Displays:	Door Mounted
1. Power On	Red lamp with normally-open contact for computer input
2. Input power	RMS AC input power readout on a 4-digit digital display (000.0 to 999.9 kilowatts) to measure ride system input power, with a buffer for analog input to a computer, scaled for 0 to 10 VDC (1 V = 110 KW)

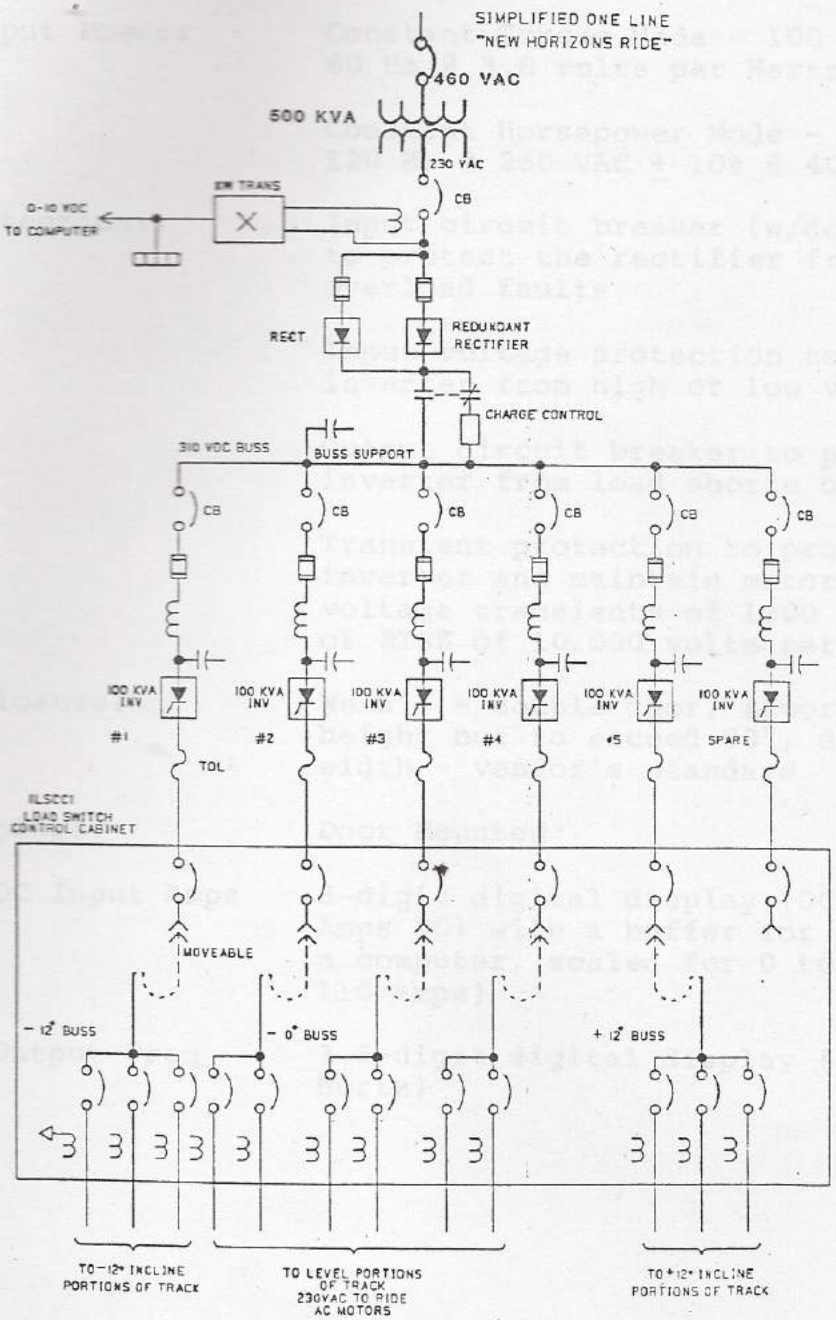


FIGURE 6A - SINGLE LINE CONTROL SYSTEM

.4 PWM Inverters

Input Voltage:	300 VDC ± 10%
Output Power:	Constant Torque Mode - 100 KVA Max @ 10 to 60 Hz @ 3.8 volts per Hertz @ 40° C ambient
	Constant Horsepower Mode - 100 KVA @ 60 to 120 Hz @ 230 VAC ± 10% @ 40° C ambient
Protection:	Input circuit breaker (w/door interlock) to protect the rectifier from inverter overload faults
	Input voltage protection to protect the inverter from high or low voltage inputs
	Output circuit breaker to protect the inverter from load shorts or faults
	Transient protection to protect the inverter and maintain motor voltage, from voltage transients of 1500 volts at a rate of RTSE of 10,000 volts per second
Enclosure:	Nema 1 - double door, floor standing, height not to exceed 90", depth and width - vendor's standard
Displays:	Door Mounted
1. DC Input Amps	3-digit digital display (000.0 to 999.0 Amps DC) with a buffer for analog input to a computer, scaled for 0 to 10 VDC (1 V = 110 Amps)
2. Output Freq	3.5-digit digital display (00.0 to 199.9 Hertz)

Thrust +12 Degree Grades

$$F = \frac{591 \text{ lbs}}{\cdot 7.9 \text{ Ft.}}$$

$$HP = \frac{591\#\ (1.8)}{550\ (.85)} = 2.28$$

$$Pwr = 2.28\ (750)\ (1.5) = 2600 \text{ Watts}$$

$$I = \frac{2600}{230} = 11.2 \text{ Amps Leg-Leg}$$

$$I = \frac{11.2}{[3]\ 1/2} = 6.2 \text{ Amps Per Line}$$

Thrust 0 Degree Grades

$$I = \frac{6.2}{1} \times \frac{115}{591} = 1.2 \text{ Amps Per Line}$$

Thrust -12 Degree Grades

$$I = \frac{6.2}{1} \times \frac{365}{591} = 3.8 \text{ Amps Per Line}$$

I.5 Load Switch Control

Refer to FIGURE 6B, which illustrates the load switch control system.

The objective of the load control cross-connect scheme is to reduce the amount of down-time through the use of a "Standby" motor control inverter to replace one of five "On Line" motor control inverters in the event of a failure.

Load Switch Control should contain:

A. Twelve 3-phase, 230 VAC, 100 Amp circuit breakers with auxiliary NO/NC contacts

B. Twelve 3.5-digit digital display current meters (0 to 100 Amps), to monitor leg current on one of the three phases

C. Door mounted panel display to indicate which power circuit is in operation

D. Tabular display to illustrate which PWM is "On Line" and what load it is servicing

E. Cross Connect - the mechanism for cross connecting source to load

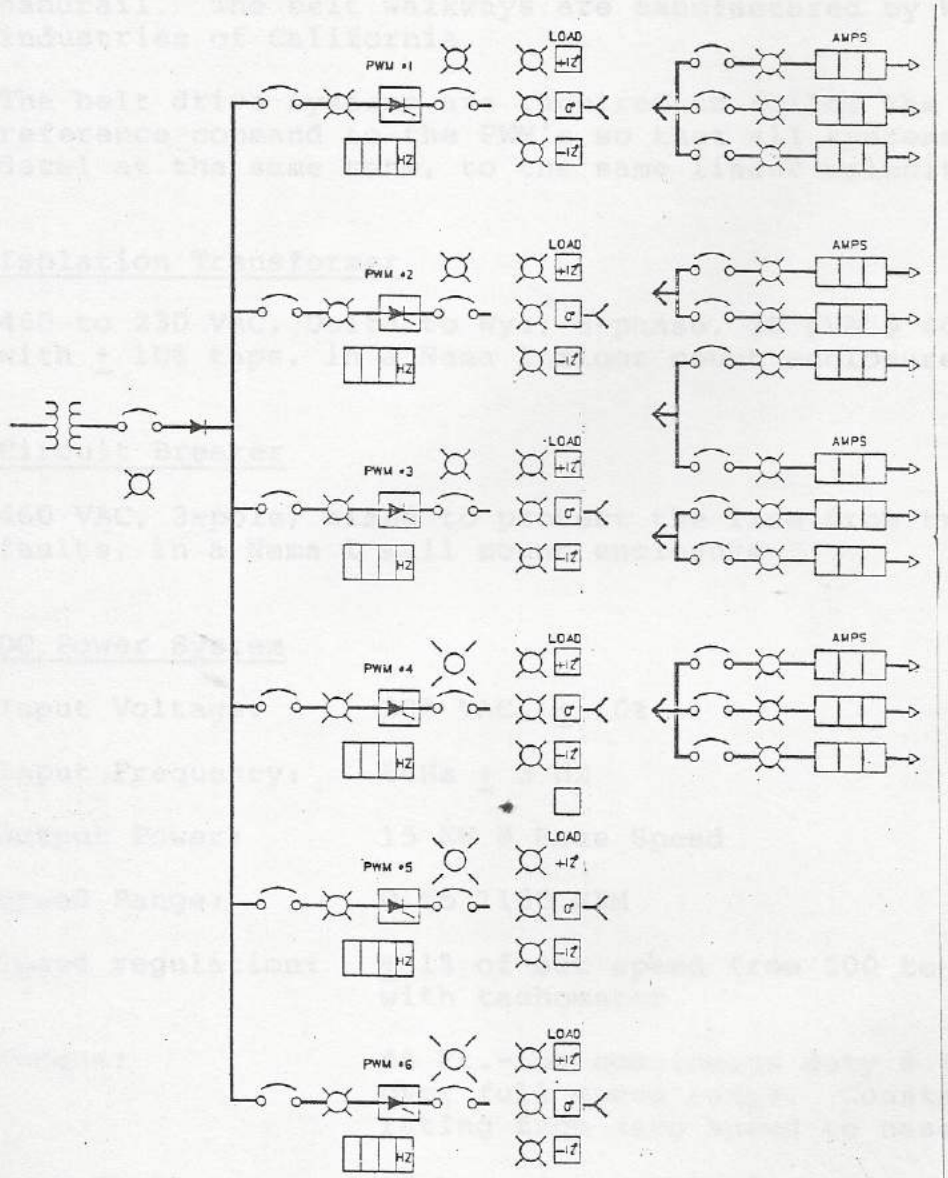


FIGURE 6B - LOAD SWITCH CONTROL SYSTEM

6.2 Load/Unload Belt System

The Load and Unload Belt Drive Systems are identical units which must be integrated into the total ride system. The Load Belt Walkway utilizes a separate drive motor for the handrail. The belt walkways are manufactured by Westmont industries of California.

The belt drive systems are required to follow the master reference command to the PWM's so that all systems accel & decel at the same rate, to the same linear velocity.

6.2.1 Isolation Transformer

460 to 230 VAC, Delta-to Wye, 3-phase, 35 KVA @ 40° C ambient, with ± 10% taps, in a Nema 1 floor mount enclosure

6.2.2 Circuit Breaker

460 VAC, 3-pole, sized to protect the line from transformer faults, in a Nema 1 wall mount enclosure

6.2.3 DC Power System

Input Voltage:	230 VAC, ± 10%
Input Frequency:	60Hz ± 3 HZ
Output Power:	15 KW @ Base Speed
Speed Range:	0 to 1150 RPM
Speed regulation:	± 1% of set speed from 500 to 1750 RPM, with tachometer
Torque:	45 Ft.-lbs continuous duty @ 40° C ambient over full speed range. Constant torque rating from zero speed to base speed
Duty Cycle:	17 hour duty cycle @ service class I to II
Acceleration:	Adjustable - from 2 to 20 seconds required to reach operating speed
Deceleration:	Adjustable - from 2 to 20 seconds required to reach zero speed
Regeneration:	Non-regenerative type system
Control:	Local manual operator panel required

6.2.4 Drive System Protection

Each drive system will incorporate relay logic to implement thermal protection (motor dual klixons), motor current overload protection, belt emergency stop, and system sequential logic. The final design must be a joint effort between General Electric and WED Engineering.

6.2.5 Enclosures

The Load Belt Drive, Unload Belt Drive, Hand Rail Drive, and Belt System relay logic will be installed in a central electrical equipment room with other ride system equipment. Therefore, the enclosure should be compatible with previously mentioned enclosures - NEMA 1, double door, floor mounted.

6.2.6 Motors

The motors for Load Belt Drive, Unload Belt Drive, and Load Belt Handrail are to be supplied by Westmont Industries, with the finished units' specifications as follows:

Load Belt

Motor type:	15 HP
Frame:	240 At
Armature voltage:	240 VDC
Winding:	Shunt wound
Torque:	50 Ft.-lb. torque (constant from zero to base speed @ 40° C ambient temp)
Brake:	Integral rear mount AC standard brake w/manual release
Speed:	1150 RPM base speed
Protection:	Dual klixons (standard) for thermal protection
Tachometer:	Extended shaft to mount an AC tach generator, @ 90 Volts per 1000 RPM

Unload Belt

Motor type:	15 HP
Frame:	240 At
Armature voltage:	240 VDC
Winding:	Shunt wound
Torque:	50 Ft.-lb. torque (constant from zero to base speed @ 40° C ambient temp)
Brake:	Integral rear mount AC standard brake w/manual release
Speed:	1150 RPM base speed
Protection:	Dual klixons (standard) for thermal protection
Tachometer:	Extended shaft to mount an AC tach generator, @ 90 Volts per 1000 RPM

Load Belt Handrail

Motor type:	1.5 HP
Frame:	186 ATC C - face mount
Field voltage	150 VDC
Armature voltage:	240 VDC
Winding:	Shunt wound
Speed:	1150 RPM base speed
Protection:	Dual klixons (standard) for thermal protection
Tachometer:	Extended shaft to mount an AC tach generator, @ 90 Volts per 1000 RPM

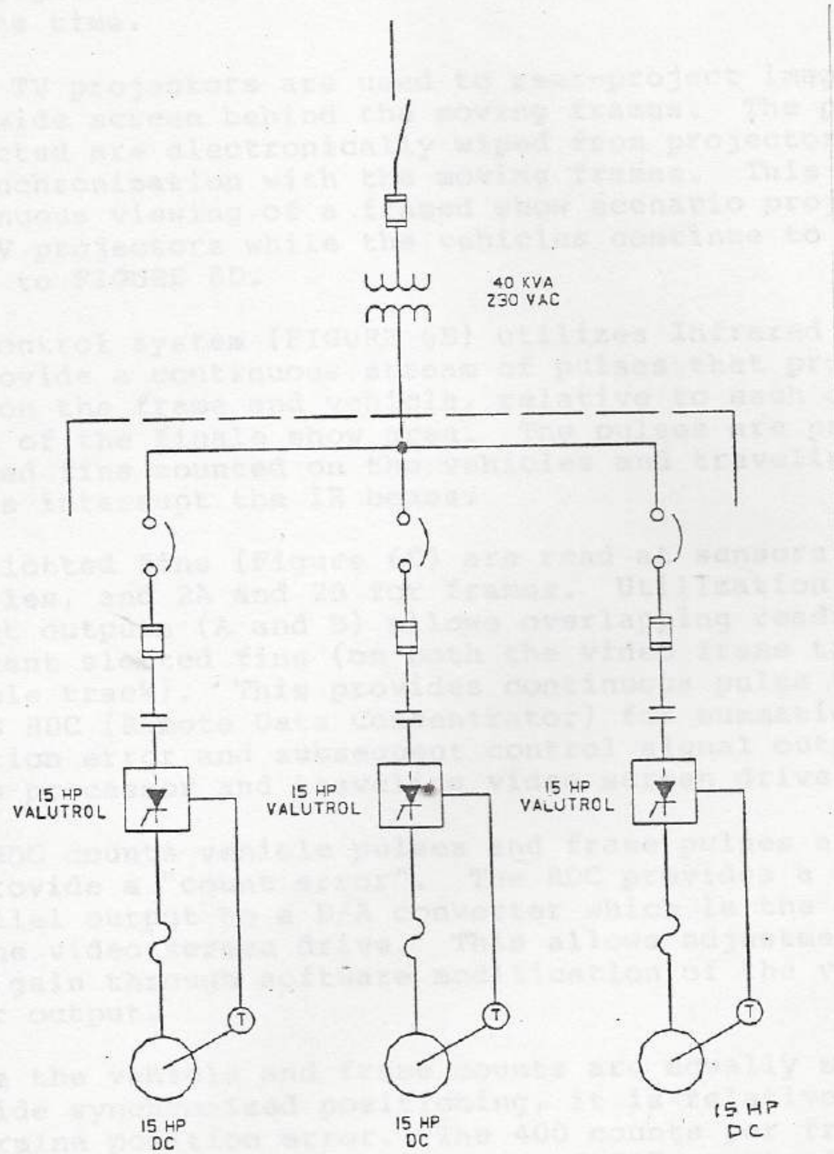


FIGURE 6C - SINGLE LINE DC CONVEYOR DRIVES

6.3 Traveling Video Finale

The Traveling Video Finale show area provides a conclusion to the ride. Nineteen picture frames moving on a track are synchronized with the ride vehicles, such that seven frames are aligned with the seven ride vehicles in the scene at any one time.

Seven TV projectors are used to rear-project images on a fifty foot wide screen behind the moving frames. The pictures being projected are electronically wiped from projector to projector in synchronization with the moving frames. This system allows continuous viewing of a framed show scenario projected from the TV projectors while the vehicles continue to be in motion. Refer to FIGURE 6D.

The control system (FIGURE 6E) utilizes Infrared (IR) sensors to provide a continuous stream of pulses that provide position data on the frame and vehicle, relative to each other, in the curve of the finale show area. The pulses are produced when slotted fins mounted on the vehicles and traveling video frames interrupt the IR beams.

The slotted fins (Figure 6D) are read at sensors 1A and 1B for vehicles, and 2A and 2B for frames. Utilization of redundant offset outputs (A and B) allows overlapping readings from two adjacent slotted fins (on both the video frame track and the vehicle track). This provides continuous pulse trains to the GPRCS RDC (Remote Data Concentrator) for summation of the position error and subsequent control signal outputs to the video processor and traveling video screen drive systems.

The RDC counts vehicle pulses and frame pulses and subtracts to provide a "count error". The RDC provides a 10 bit parallel output to a D/A converter which is the control signal to the video screen drive. This allows adjustment of position loop gain through software modification of the volts-per-count error output.

Since the vehicle and frame counts are equally weighted to provide synchronized positioning, it is relatively easy to determine position error. The 400 counts per frame is based on the video control requirement of 267 counts for a 60 HZ vertical sweep, at 18 inches per second frame speed.

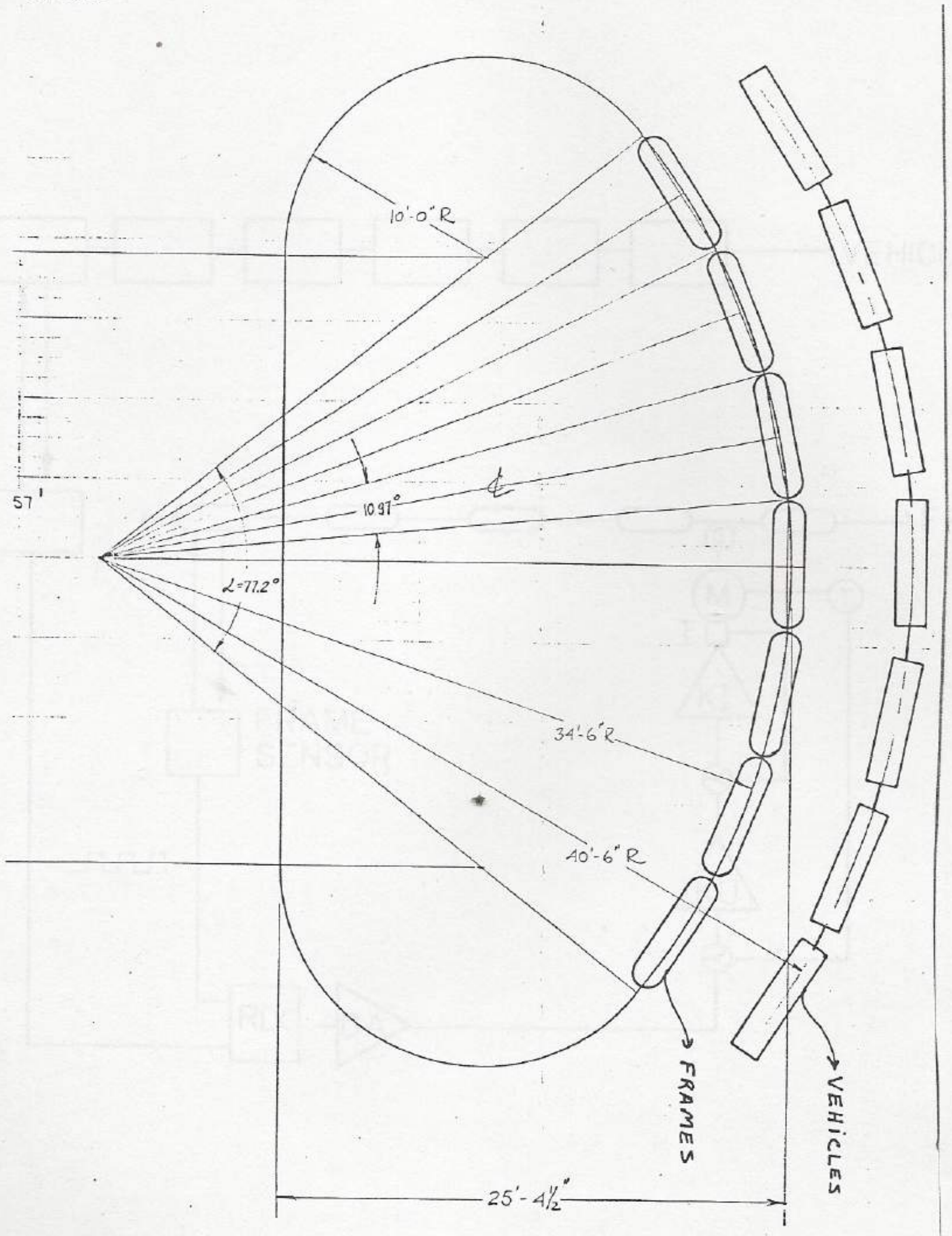


FIGURE 6D - VEHICLE/TRAVELING VIDEO SCREEN LAYOUT

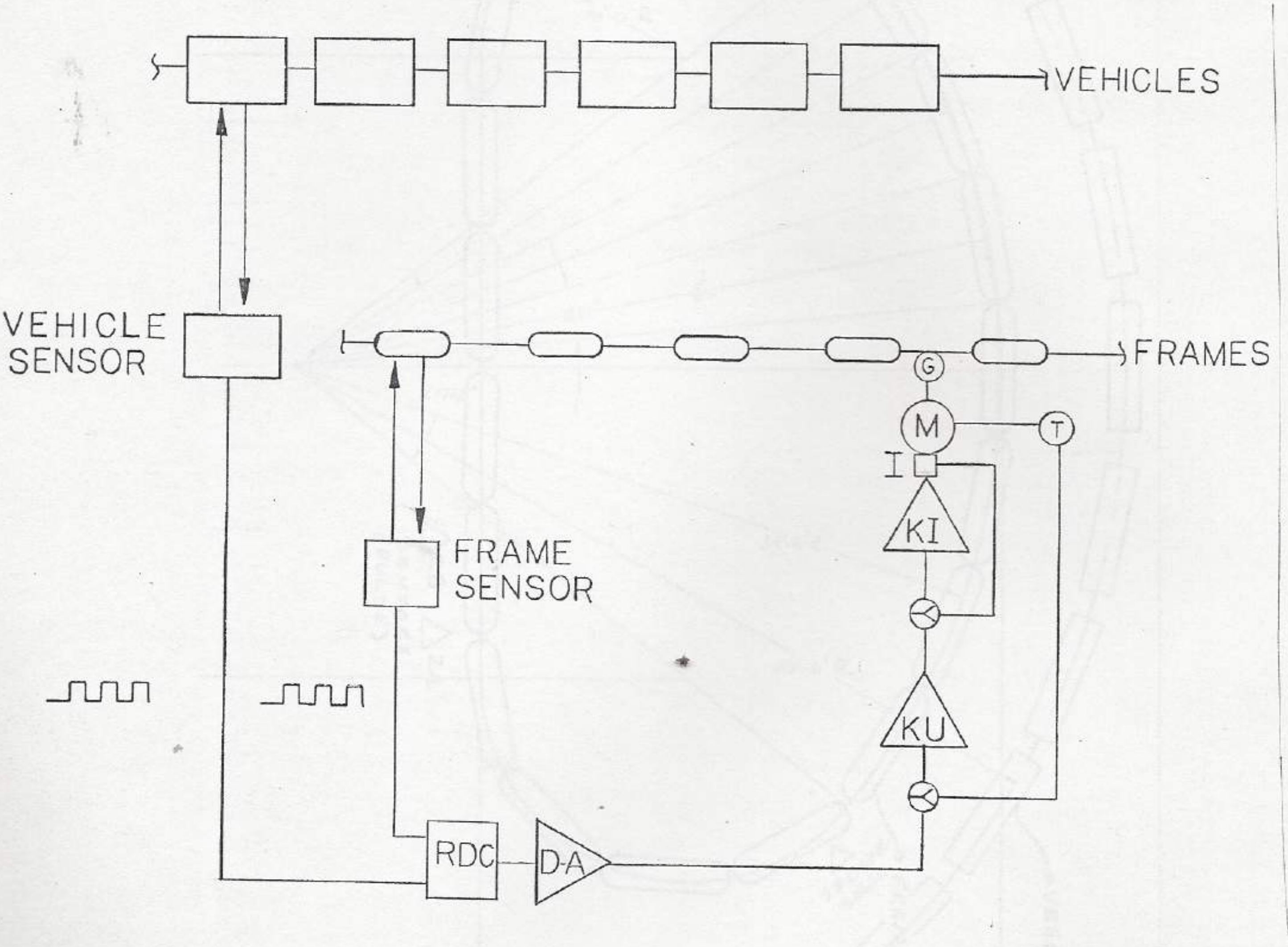


FIGURE 6E - TRAVELING VIDEO/SCREEN CONTROL SYSTEM

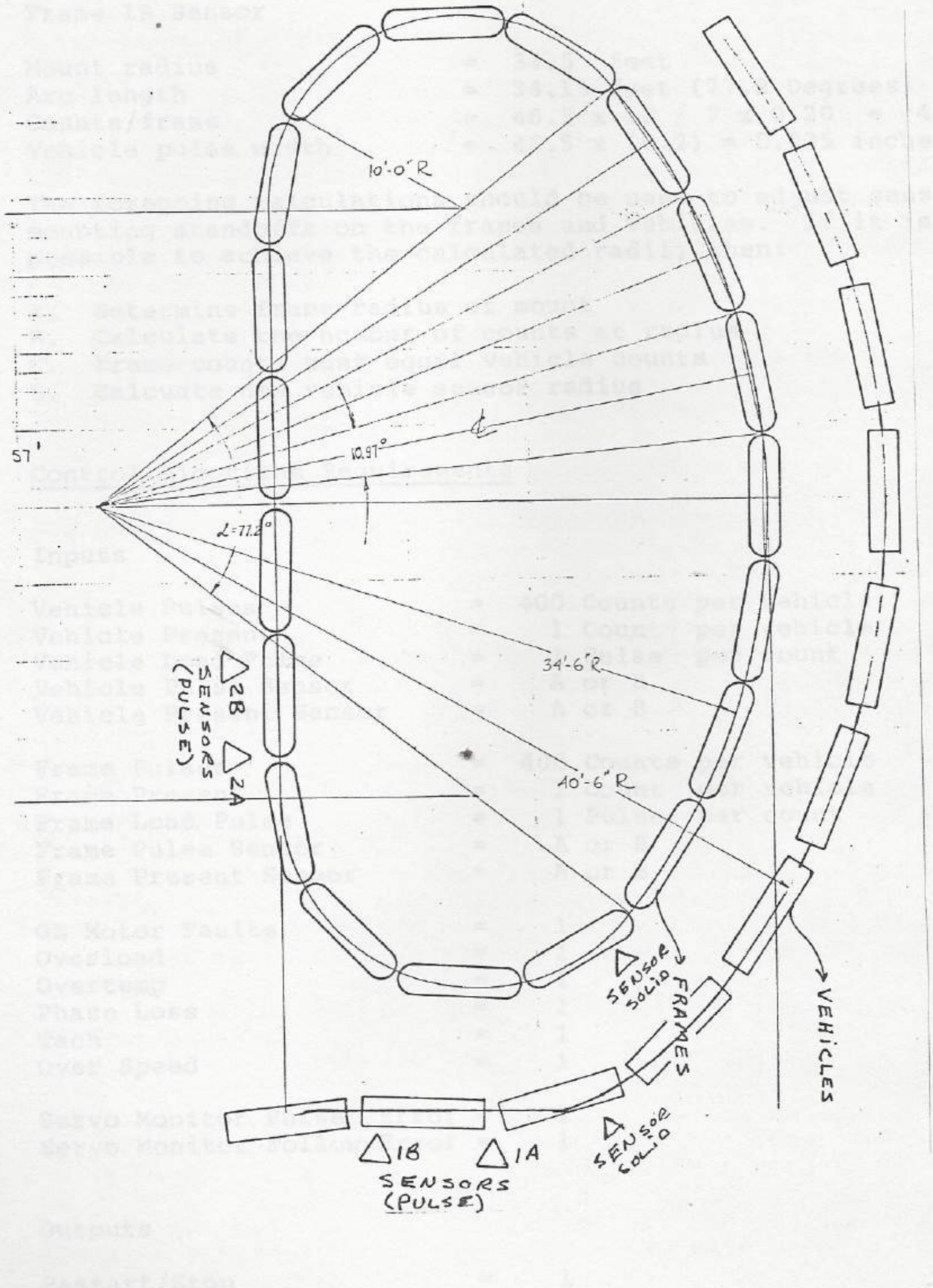


FIGURE 6F - TRAVELING VIDEO SCREEN/VEHICLE GEOMETRY

6.4 IR Sensor Geometry

Frame IR Sensor

Mount radius	= 34.5 feet
Arc length	= 34.15 feet (77.2 Degrees)
Counts/frame	= 46.5 x 12 / 7 x 0.20 = 400
Vehicle pulse width	= 40.5 x (0.2) = 0.235 inches

The foregoing calculations should be used to adjust sensor mounting standoffs on the frames and vehicles. If it is not possible to achieve the calculated radii, then:

A. Determine frame radius of mount
B. Calculate the number of counts at radius
C. Frame counts must equal vehicle counts
D. Calcuate new vehicle sensor radius

6.5 Control Algorithm Requirements

Inputs

Vehicle Pulses	= 400 Counts per vehicle
Vehicle Present	= 1 Count per vehicle
Vehicle Load Pulse	= 1 Pulse per count
Vehicle Pulse Sensor	= A or B
Vehicle Present Sensor	= A or B
Frame Pulses	= 400 Counts per vehicle
Frame Present	= 1 Count per vehicle
Frame Load Pulse	= 1 Pulse per count
Frame Pulse Sensor	= A or B
Frame Present Sensor	= A or B
GE Motor Faults	= 1
Overload	= 1
Overtemp	= 1
Phase Loss	= 1
Tach	= 1
Over Speed	= 1
Servo Monitor Pulse Error	= 1
Servo Monitor Follow Error	= 1

Outputs

Restart/Stop	= 1
Start/Stop	= 1
Analog Position Error	= 0 to -10 VDC

6.6 Maintenance Control Systems

6.6.1 Maintenance Stations

Three maintenance stations, spaced approximately 400 feet apart, provide for preventive maintenance and repairs on the track. The fourth station is at the maintenance area switch and can be used to remove and replace a vehicle from spares kept on the 200 foot track in the vehicle maintenance area.

Each maintenance station is equipped with the following ride control equipment:

Power On Indicator	Green indicator light
Reset/Stop Switch	Momentary button
Lo/High Speed Switch	Off/On locked switch
Jog Switch	Momentary button
E-Stop Switch	Maintained button, enclosed in a padlock lockable enclosure
Vehicle Green Light Sensor	Optical offboard IR sensor to provide a "maintenance stop" function at any maintenance station

6.6.2 Maintenance Area and Spare Vehicle Track

A track switch connects the ride track (through a 75 foot corridor) with a 200 foot maintenance area track. In addition, another switch on the maintenance track allows loading of vehicles from trucks to the maintenance track.

The maintenance area is equipped with the following ride control equipment:

Track Switch Controls (120 VAC Pneumatic Valves)	E-Stop lockout switch Trackswitch rotate to 0 Degrees Trackswitch rotate to 90 Degrees
Vehicle Control (Pendant Station)	Momentary "GO" button FWD - REV switch
Vehicle Power	100-foot power cable reel 3-pole reversing motor contactor

.7 Slide-rail Bus Bar Power Feed

All vehicle voltage is fed from the eight channel bus bar (FIGURE 6G) through a vehicle collector (power pick-up) on every vehicle. Power bus channels are assigned as follows:

Channel 1	Inverter L1
Channel 2	Inverter L2
Channel 3	Inverter L3
Channel 4	Building Ground
Channel 5	120 VAC L1
Channel 6	120 VAC L2 (Neutral)
Channel 7	230 VAC L2 (Neutral)
Channel 8	230 VAC L1

Power bus bar channels are separated into forty isolated sections which are fed from eleven circuit breakers. The eleven 230 VAC circuit breakers are in the Facilities Electrical Cabinet in the ride equipment room.

The circuit breakers for the three inverter channels are located in the Load Control Switch cabinet in the ride equipment room. Individual bus bar channels are rated at 100 Amps continuous service. Therefore, the Load Switch Control cabinet provides load distribution and protection as well as standby inverter switching capability.

The 120 VAC bus bar feed is controlled from each of four maintenance stations by Electrical Facilities Engineering.

Inverter isolation points are eight inches long to allow motor stator fields and currents to reduce to a negligible level at normal ride speed. The isolation point locations are critical to ride load considerations.

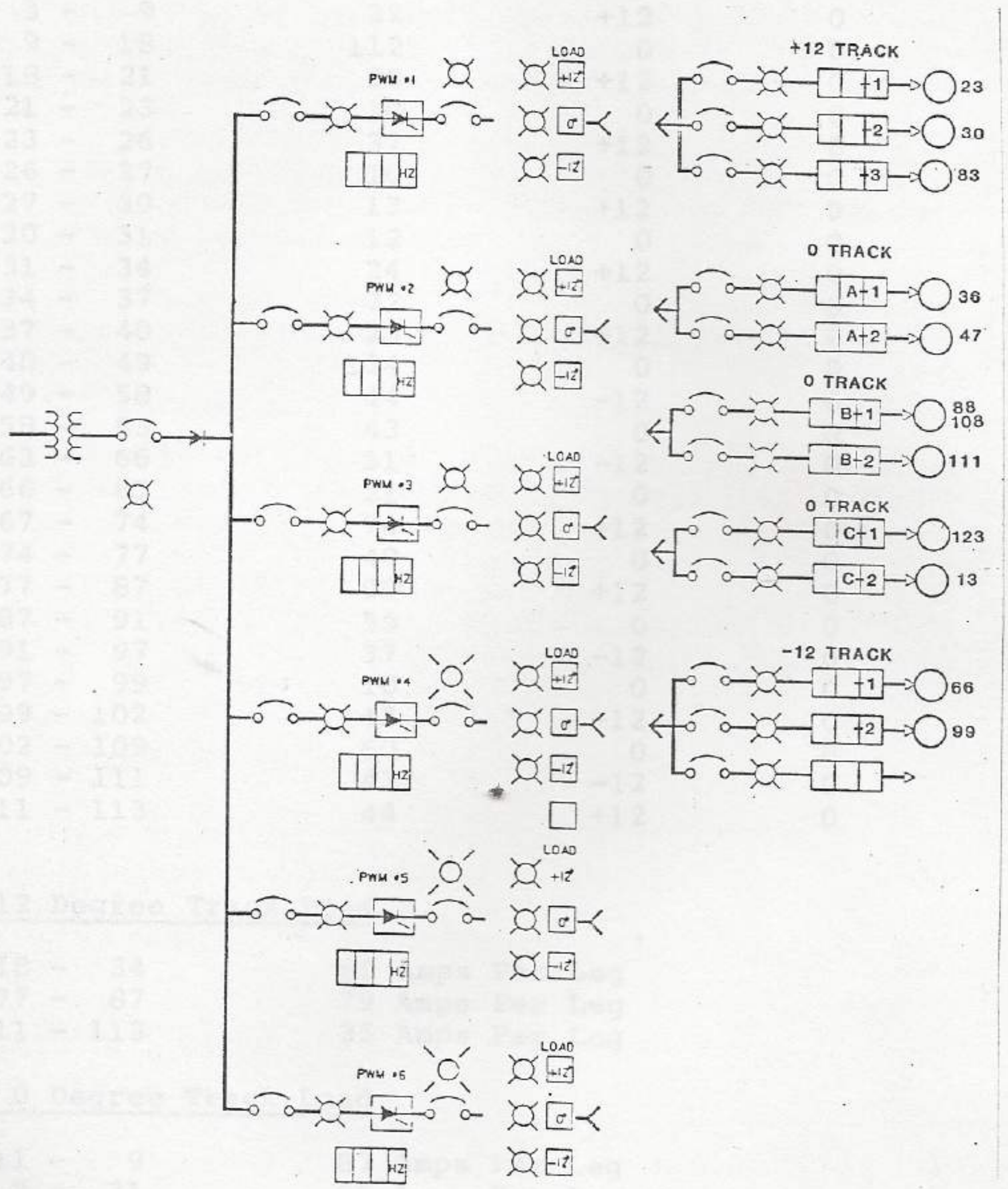


FIGURE 6G - BUS BAR POWER DISTRIBUTION SYSTEM

TRACK PROFILE (Refer to Dwg C3PD-XZ)

POSITION (Ref)	LENGTH (Feet)	ANGLE (Degrees)	BUS 1	BUS 2
113 - 3	172	0	0	
3 - 9	32	+12	0	
9 - 18	112	0	0	
18 - 21	30	+12	0	
21 - 23	10	0	0	
23 - 26	37	+12	0	
26 - 27	10	0	0	
27 - 30	13	+12	0	
30 - 31	12	0	0	
31 - 34	24	+12	0	
34 - 37	72	0	0	
37 - 40	23	+12	0	
40 - 49	134	0	0	
49 - 58	44	-12	0	
58 - 63	43	0	0	
63 - 66	51	-12	0	
66 - 67	21	0	0	
67 - 74	74	-12	0	
74 - 77	40	0	0	
77 - 87	98	+12	0	
87 - 91	59	0	0	
91 - 97	37	-12	0	
97 - 99	10	0	0	
99 - 102	43	-12	0	
102 - 109	60	0	0	
109 - 111	43	-12	0	
111 - 113	44	+12	0	

<u>+12 Degree Track Load</u>

18 - 34	88 Amps Per Leg
77 - 87	79 Amps Per Leg
111 - 113	35 Amps Per Leg

<u>0 Degree Track Load</u>

111 - 9	87 Amps Per Leg
9 - 31	86 Amps Per Leg
31 - 58	91 Amps Per Leg
58 - 77	77 Amps Per Leg
77 - 91	87 Amps Per Leg
91 - 111	71 Amps Per Leg

<u>-12 Degree Track Load</u>

63 - 74	65 Amps Per Leg
91 - 111	62 Amps Per Leg

7.0 GPRCS MONITOR SYSTEM

The Ride Control Computer (RCC 01) serves as the central element of the monitor and diagnostic system (FIGURE 6H). RCC 01 utilizes parallel and serial inputs and outputs.

The objective of this RCC-controlled monitor system requires that the software be flexible enough to accept the following changes without changing the basic structure of the software program.

A. Additional inputs
B. Changes and additions to the system diagnostic
C. Output message changes

7.1 Parallel Inputs

inputs	from	to
30	GE Inverters	RPB 01
20	GE System Control	RPB 02
12	Ride Track	RPB 02
16	E-Stop Monitor	RPB 03
10	Stop Monitor	RPB 03
24	(4) DC Motor Controls	RPB 04
	Expansion	RPB 05

7.2 Serial Inputs

inputs	from	to
2	RDC 01 & RDC 02	RCC 01
5	IR Track Cans	RCC 01
1	Terminal	RCC 01

7.3 Parallel Outputs

inputs	from	to
1 (NC)	RPB 01	GE E-Stop

7.4 Serial Outputs

inputs	from	to
1	RCC 01	ROC 01 (DCM)
1	RCC 01	ROC 03 (DCM)
1	RCC 01	Printer

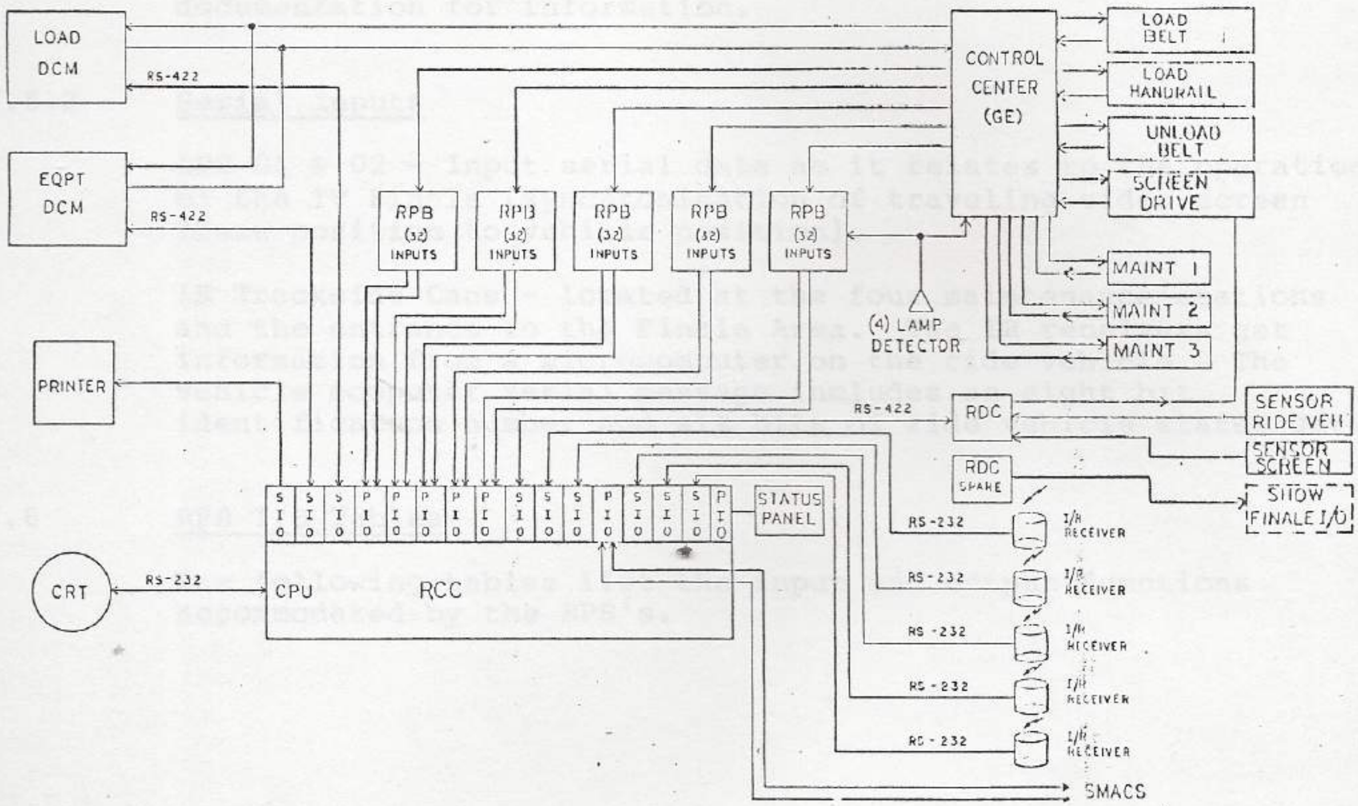


FIGURE 7A - GPRCS BLOCK DIAGRAM

7.5 Monitor System Messages

The RCC 01 monitor system utilizes serial outputs to two console CRT's (Load Console and Ride Equipment Room Console) to display system operational messages and maintenance messages. In addition, the printer (in the Equipment Room) provides a hard copy for maintenance messages.

7.5.1 Hardware Displays

The GE Equipment utilizes a number of displays to assist the maintenance personnel. Refer to the GE inverter system documentation for information.

7.5.2 Serial Inputs

RDC 01 & 02 - Input serial data as it relates to the operation of the TV Finale (synchronization of traveling video screen frame position to vehicle position).

IR Trackside Cans - located at the four maintenance stations and the entrance to the Finale Area. The IR receivers get information from a microcomputer on the ride vehicle. The vehicle computer serial message includes an eight bit identification number and six bits of ride vehicle status data.

7.6 RPB I/O Tables

The following tables list the input and output functions accommodated by the RPB's.

RPB 01 INPUT/OUTPUT

Inputs: 30
Outputs: 0

INPUT	FUNCTION	NORMAL RUN STATE	FROM	TO
1IOT	OVERTEMP	NC	PWM 01	RPB 01
1IOL	OVERLOAD	NC	PWM 01	RPB 01
1IFLT	PWM RDY OR STBY	NC	PWM 01	RPB 01
1TFLT	PWM 01 FAULT	NC	PWM 01	RPB 01
1RUNX	PWM READY	NC	PWM 01	RPB 01
2IOT	OVERTEMP	NC	PWM 02	RPB 01
2IOL	OVERLOAD	NC	PWM 02	RPB 01
2IFLT	PWM RDY OR STBY	NC	PWM 02	RPB 01
2TFLT	PWM 02 FAULT	NC	PWM 02	RPB 01
2RUNX	PWM READY	NC	PWM 02	RPB 01
3IOT	OVERTEMP	NC	PWM 03	RPB 01
3IOL	OVERLOAD	NC	PWM 03	RPB 01
3IFLT	PWM RDY OR STBY	NC	PWM 03	RPB 01
3TFLT	PWM 03 FAULT	NC	PWM 03	RPB 01
3RUNX	PWM READY	NC	PWM 03	RPB 01
4IOT	OVERTEMP	NC	PWM 04	RPB 01
4IOL	OVERLOAD	NC	PWM 04	RPB 01
4IFLT	PWM RDY OR STBY	NC	PWM 04	RPB 01
4TFLT	PWM 04 FAULT	NC	PWM 04	RPB 01
4RUNX	PWM READY	NC	PWM 04	RPB 01
5IOT	OVERTEMP	NC	PWM 05	RPB 01
5IOL	OVERLOAD	NC	PWM 05	RPB 01
5IFLT	PWM RDY OR STBY	NC	PWM 05	RPB 01
5TFLT	PWM 05 FAULT	NC	PWM 05	RPB 01
5RUNX	PWM READY	NC	PWM 05	RPB 01
6IOT	OVERTEMP	NC	PWM 06	RPB 01
6IOL	OVERLOAD	NC	PWM 06	RPB 01
6IFLT	PWM RDY OR STBY	NC	PWM 06	RPB 01
6TFLT	PWM 06 FAULT	NC	PWM 06	RPB 01
6RUNX	PWM READY	NC	PWM 06	RPB 01

RPB 02 INPUT/OUTPUT

Inputs: 24
Outputs: 0

INPUT	FUNCTION	NORMAL RUN STATE	FROM	TO
RST	RIDE RESET	NC	MCC 01	RPB 02
STP	RIDE STOP	NC	MCC 01	RPB 02
LO SPD	LOW SPEED	NC	MCC 01	RPB 02
HI SPD	HIGH SPEED	NC	MCC 01	RPB 02
BRAKE	BRAKES OFF	NC	MCC 01	RPB 02
1CBX	CIRCUIT BREAKER 1	NC	MCC 01	RPB 02
2CBX	CIRCUIT BREAKER 2	NC	MCC 01	RPB 02
3CBX	CIRCUIT BREAKER 3	NC	MCC 01	RPB 02
4CBX	CIRCUIT BREAKER 4	NC	MCC 01	RPB 02
5CBX	CIRCUIT BREAKER 5	NC	MCC 01	RPB 02
6CBX	CIRCUIT BREAKER 6	NC	MCC 01	RPB 02
7CBX	CIRCUIT BREAKER 7	NC	MCC 01	RPB 02
8CBX	CIRCUIT BREAKER 8	NC	MCC 01	RPB 02
9CBX	CIRCUIT BREAKER 9	NC	MCC 01	RPB 02
10CBX	CIRCUIT BREAKER 10	NC	MCC 01	RPB 02
11CBX	CIRCUIT BREAKER 11	NC	MCC 01	RPB 02
12CBX	CIRCUIT BREAKER 12	NC	MCC 01	RPB 02
1RTS	1 DC RECT OVERTEMP	NC	MCC 01	RPB 02
2RTS	2 DC RECT OVERTEMP	NC	MCC 01	RPB 02
3RTS	3 DC RECT OVERTEMP	NC	MCC 01	RPB 02
ESTOP	E STOP FUNCTION	NC	MCC 01	RPB 02
PR1	INVERTER PERM RUN 1	NC	MCC 01	RPB 02
PR2	INVERTER PERM RUN 2	NC	MCC 01	RPB 02
S RUN	ALL GE EQPT RUN	NC	MCC 01	RPB 02

RPB 03 INPUT/OUTPUT

Inputs: 23
Outputs: 0

INPUT	FUNCTION	NORMAL RUN STATE	FROM	TO
LDE	LOAD CONSOLE E STOP	NC	ROC 01	RPB 03
ULDE	UNLOAD CONSOLE E STOP	NC	ROC 02	RPB 03
EQPTE	EQPT CONSOLE E STOP	NC	ROC 03	RPB 03
M1E	MAINT STA 1 E STOP	NC	RMS 01	RPB 03
M1E	MAINT STA 1 E STOP	NC	RMS 01	RPB 03
M2E	MAINT STA 2 E STOP	NC	RMS 02	RPB 03
M2E	MAINT STA 2 E STOP	NC	RMS 02	RPB 03
M3E	MAINT STA 3 E STOP	NC	RMS 03	RPB 03
M3E	MAINT STA 3 E STOP	NC	RMS 03	RPB 03
M4E	MAINT STA 4 E STOP	NC	RMS 04	RPB 03
M4E	MAINT STA 4 E STOP	NC	RMS 04	RPB 03
TRKSWE	TRACK SWITCH E STOP	NC	RTS 01	RPB 03
TRKLKE	TRACK LOCK E STOP	NC	RTS 01	RPB 03
TRKLME	TRACK LIMIT E STOP	NC	RTS 01	RPB 03
TRKPE	TRACK PUSHBUTTON E STOP LOCAL E STOP	NC	RTS 01	RPB 03
LDBLTE	LOAD BELT COMB SWITCH	NC	ROC 01	RPB 03
ULDBLTE	UNLOAD BELT COMB SWITCH	NC	ROC 02	RPB 03
STOP	MAINT STA 1 STOP	NC	RMS 01	RPB 03
STOP	MAINT STA 2 STOP	NC	RMS 02	RPB 03
STOP	MAINT STA 3 STOP	NC	RMS 03	RPB 03
STOP	MAINT STA 4 STOP	NC	RMS 04	RPB 03
STOP	LOAD CONSOLE STOP	NC	ROC 01	RPB 03
STOP	UNLOAD CONSOLE STOP	NC	ROC 02	RPB 03
STOP	EQPT CONSOLE STOP	NC	ROC 03	RPB 03
STOP	TRACK SWITCH STOP	NC	RTS 01	RPB 03
STOP	TRACK CRACK DETECT 1	NC	RTD 01	RPB 03
STOP	TRACK CRACK DETECT 2	NC	RTD 02	RPB 03
STOP	TRACK CRACK DETECT 3	NC	RTD 03	RPB 03

RPB 04 INPUT/OUTPUT

Inputs: 24
Outputs: 0

INPUT	FUNCTION	NORMAL RUN STATE	FROM	TO
6RUNX	LOAD BELT RUN	NC	RMC 01	RPB 04
6TOL	OVERTEMP	NC	RMC 01	RPB 04
6OLX	OVERLOAD	NC	RMC 01	RPB 04
6PR	RDY TO RUN	NC	RMC 01	RPB 04
6AUTO	AUTO MODE	NC	RMC 01	RPB 04
6BR	BRAKE	NC	RMC 01	RPB 04
7RUNX	UNLOAD BELT RUN	NC	RMC 02	RPB 04
7TOL	OVERTEMP	NC	RMC 02	RPB 04
7OLX	OVERLOAD	NC	RMC 02	RPB 04
7PR	RDY TO RUN	NC	RMC 02	RPB 04
7AUTO	AUTO MODE	NC	RMC 02	RPB 04
7BR	BRAKE	NC	RMC 02	RPB 04
8RUNX	HANDRAIL RUN	NC	RMC 03	RPB 04
8TOL	OVERTEMP	NC	RMC 03	RPB 04
8OLX	OVERLOAD	NC	RMC 03	RPB 04
8PR	RDY TO RUN	NC	RMC 03	RPB 04
8AUTO	AUTO MODE	NC	RMC 03	RPB 04
8BR	BRAKE	NC	RMC 03	RPB 04
9RUNX	FRAME RUN	NC	RMC 04	RPB 04
9TOL	OVERTEMP	NC	RMC 04	RPB 04
9OLX	OVERLOAD	NC	RMC 04	RPB 04
9PR	RDY TO RUN	NC	RMC 04	RPB 04
9AUTO	AUTO MODE	NC	RMC 04	RPB 04
9BR	BRAKE	NC	RMC 04	RPB 04

RPB 05 INPUT/OUTPUT

Inputs: 12
Outputs: 0

INPUT	FUNCTION	NORMAL RUN STATE	FROM	TO
INV 1	INV 1 STBY	NC	MCC 01	RPB 05
INV 2	INV 2 STBY	NC	MCC 01	RPB 05
INV 3	INV 3 STBY	NC	MCC 01	RPB 05
INV 4	INV 4 STBY	NC	MCC 01	RPB 05
INV 5	INV 5 STBY	NC	MCC 01	RPB 05
INV 6	INV 6 STBY	NC	MCC 01	RPB 05
SS1	STA SELECT LOAD	NC	MCC 01	RPB 05
SS2	STA SELECT EQPT	NC	MCC 01	RPB 05
SS3	STA SELECT M1	NC	MCC 01	RPB 05
SS4	STA SELECT M2	NC	MCC 01	RPB 05
SS5	STA SELECT M3	NC	MCC 01	RPB 05
SS6	STA SELECT M4	NC	MCC 01	RPB 05

8.0 RIDE STOP SYSTEMS

The mechanisms that are utilized to stop all or part of the Ride Control System are outlined below:

8.1 Ride E-Stop

Utilized to protect guests, WDW personnel, and equipment. When actuated, these devices stop all moving equipment via the Ride Control System.

Ride E-Stop pushbutton locations:

Load Console
Unload Console
Equipment Console
Maintenance Stations 1 through 4
Track Switch Interlock
Track Switch Control
Handpacks

8.2 Belt E-Stop

A belt E-Stop stops only the associated load or unload belt.

Belt E-Stop switch locations:

Belt comb plates

8.3 Controlled Stop

Stops all ride equiment with a controlled linear deceleration.

Manual Ride Stop control locations:

Load Console
Unload Console
Equipment Console
Maintenance Stations 1 through 4

Automatic Ride Stop control locations:

Vehicle Green Light Detector 1 through 4
Pipe Track Detector 1 through 3

9.0 OPERATOR CONSOLES

Three Operator Consoles (DCM's), ROC 01, ROC 02, and ROC 03, are utilized for operation of the Ride Control System. The functions and locations of the Operator Consoles are detailed as follows:

9.1 Load Console - ROC 01

Located in ride passenger loading area adjacent to the load belt walkway.

9.1.1 Touchscreen Control Functions

Parallel outputs

1. Ride Reset/Stop - alternate action to GE MCC 01
2. Ride Lo/Hi Speed - alternate action to GE MCC 01 speed control
3. Command Enter/Cancel - required to enter all commands except Lo/Hi speed
4. Frames Start/Stop - starts frame drives via GE/MCC 01
5. Load Belt Start/Stop - starts load belt walkway and handrail drives via GE/MCC 01

Parallel inputs

1. Ride Reset - acknowledge ride reset
2. Ride Speed - acknowledge Lo or Hi speed
3. Frame Start - acknowledge frame start
4. Load Belt Start - acknowledge load belt start
5. Unload Belt Run - monitor unload belt status

Serial inputs

A portion of the Touchscreen CRT is used to display messages for Operations and Maintenance personnel. This data is sent from the RCC 01 Monitor Computer via a serial link.