LIGHTING ESSENTIALS FOR A/V PROFESSIONALS

MICHAEL BROUGHTON, SUNY CORTLAND

MICHAEL BROUGHTON

- Former Entertainment Lighting Technician
  - Merry-Go-Round Playhouse & Finger Lakes Musical Theatre Festival
  - Portland Center Stage
  - Freelance in NYC
  - Touring Lighting Supervisor, Moscow Ballet
  - Massachusetts Museum of Contemporary Art (MassMOCA)

SUNY CORTLAND'S SESQUICENTENNIAL CELEBRATION

150

SUNY Cortland

Sesquicentennial

DESIGN CONSIDERATIONS

- What are the controllable properties of light?

    - Intensity

    - Angle

    - Color

    - Distribution

    - Movement

INTENSITY –
HOW BRIGHT IS THE LIGHT?

- Lighting sources can be measured in lumens.

- The amount of light on a subject can be measured in footcandles or lux.

  - For lighting a person giving a speech or presentation on a stage, I use a rough goal of 75 footcandles.
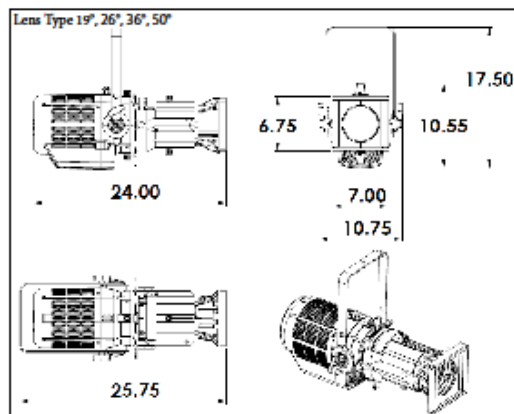
SUMMARY

The 5°, 10°, 19°, 26°, 36° and 50° fixed focus PHX LED ellipsoidals are state of the art luminaires in function, style, and efficiency. These ellipsoidals have been designed and engineered with a number of innovative details and features enhancing versatility and efficiency without sacrificing performance.

A diverse line of LED choices are available in 250 watt RGBA, RGBW, 3000k, 5600k, and tunable white 3000k/5600k.

Fully locking shutters and a 360° rotating barrel help keep your keep the artistic part of your fixtures focus intact and easy to attain, and with virtually no light leak from the fixture itself you wont have to worry about any extra light illuminating unwanted parts of the ceiling. The aesthetic appearance and ergonomically designed function controls only add to the appeal.

These new and innovative options are what makes the PHX LED ellipsoidals ideal for theatres, Special Events, television studios, or wherever superior, energy efficient lighting performance is required.

NEW PRODUCT
AWARDS WINNER
2014

plasa
MEMBERS
CHOICE
awards 2013
WINNER

Lens Type 19°, 26°, 36°, 50°

17.50
6.75   10.55
24.00
7.00
10.75
25.75

FEATURES

- 360 degree rotating barrel
- Locking Shutters
- Completely enclosed accessory holder
- Heat resistant Plano-Convex lensing
- Die cast aluminum and sheet metal fabrication
- Color frame, C-Clamp, Soft Focus Pattern holder, Safety cable, 5 Foot PowerCON included
- Carries standard three year Altman Warranty
- Tool free interchangeable barrels
- 26.5 lbs. (12kgs)
- ETL, cETL, & CE listed
- Assembled in the USA

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RGBA PERFORMANCE

5 Degree

Throw Distance (d)	20' 6m	30' 9m	40' 12.2m	50' 15.2m	60' 18.28m	70' 21.33m	80' 24.38m	90' 27.43m	100' 30.48m	110' 33.52m
Beam Size Diameter	2.40' 0.73m	3.60' 1.09m	4.80' 1.46m	6.00' 1.82m	7.20' 2.19m	8.40' 2.56m	9.60' 2.92m	10.80' 3.29m	12.00' 3.65m	13.20' 4.02m
Illuminance = fc (Illuminance = lux)	754.75 (8124.05)	335.44 (3610.69)	188.69 (2031.01)	120.76 (1299.84)	83.86 (902.67)	61.61 (663.18)	47.17 (507.75)	37.27 (401.18)	30.19 (324.96)	24.95 (268.56)

10 Degree

Throw Distance (d)	20' 6m	30' 9m	40' 12.2m	50' 15.2m	60' 18.28m	70' 21.33m	80' 24.38m	90' 27.43m	100' 30.48m	110' 33.52m
Beam Size Diameter	3.00' 0.91m	4.50' 1.37m	6.00' 1.82m	7.50' 2.286m	9.00' 2.74m	10.50' 3.20m	12.00' 3.65m	13.50' 4.11m	15.00' 4.57m	16.50' 5.02m
Illuminance = fc (Illuminance = lux)	455.00 (4897.57)	202.22 (2176.70)	113.75 (1224.39)	72.80 (783.61)	50.56 (544.17)	37.14 (399.80)	28.44 (306.09)	22.47 (24...)	18.20	15.04

19 Degree

Throw Distance (d)	10' 3m	15' 4.6m	20' 6m	25' 7.6m	30' 9m	35' 10.7m	40' 12.2m	13...		
Beam Size Diameter	3.10' 0.94m	4.65' 1.41m	6.20' 1.88m	7.75' 2.36m	9.30' 2.83m	10.85' 3.30m	12.40' 3.77m	13... 4.2...		
Illuminance = fc (Illuminance = lux)	491.00 (5285.07)	218.22 (2348.92)	122.75 (1321.26)	78.56 (845.61)	54.56 (587.23)	40.08 (431.43)	30.69 (330...)	(26...)		

26 Degree

Throw Distance (d)	10' 3m	15' 4.6m	20' 6m	25' 7.6m	30' 9m	35' 10.7m	40' 12.2m	45' 13.7m	50' 15.2m	55' 16.78m
Beam Size Diameter	4.55' 1.38m	6.83' 2.08m	9.10' 2.77m	11.38' 3.46m	13.65' 4.16m	15.93' 4.85m	18.20' 5.54m	20.48' 6.24m	22.75' 6.93m	25.03' 7.62m
Illuminance = fc (Illuminance = lux)	250.00 (2690.97)	111.11 (1195.98)	62.50 (672.74)	40.00 (430.55)	27.78 (298.99)	20.41 (219.67)	15.63 (168.18)	12.35 (132.88)	10.00 (107.63)	8.26 (88.95)

26 Degree

Throw Distance (d)	10' 3m	15' 4.6m	20' 6m	25' 7.6m	30' 9m
Beam Size Diameter	4.55' 1.38m	6.83' 2.08m	9.10' 2.77m	11.38' 3.46m	13.65' 4.16m
Illuminance = fc (Illuminance = lux)	250.00 (2690.97)	111.11 (1195.98)	62.50 (672.74)	40.00 (430.55)	27.78 (298.99)

36 Degree

Throw Distance (d)	10' 3m	15' 4.6m	20' 6m	25' 7.6m	30' 9m	35' 10.7m	40' 12.2m	45' 13.7m	50' 15.2m	55' 16.78m
Beam Size Diameter	6.10' 1.85m	9.15' 2.78m	12.20' 3.71m	15.25' 4.64m	18.30' 5.57m	21.35' 6.50m	24.40' 7.43m	27.45' 8.36m	30.50' 9.29m	33.55' 10.22m
Illuminance = fc (Illuminance = lux)	156.00 (1679.16)	69.33 (746.29)	39.00 (419.79)	24.96 (268.66)	17.33 (186.57)	12.73 (137.07)	9.75 (104.94)	7.70 (82.92)	6.24 (67.16)	5.16 (55.50)

50 Degree

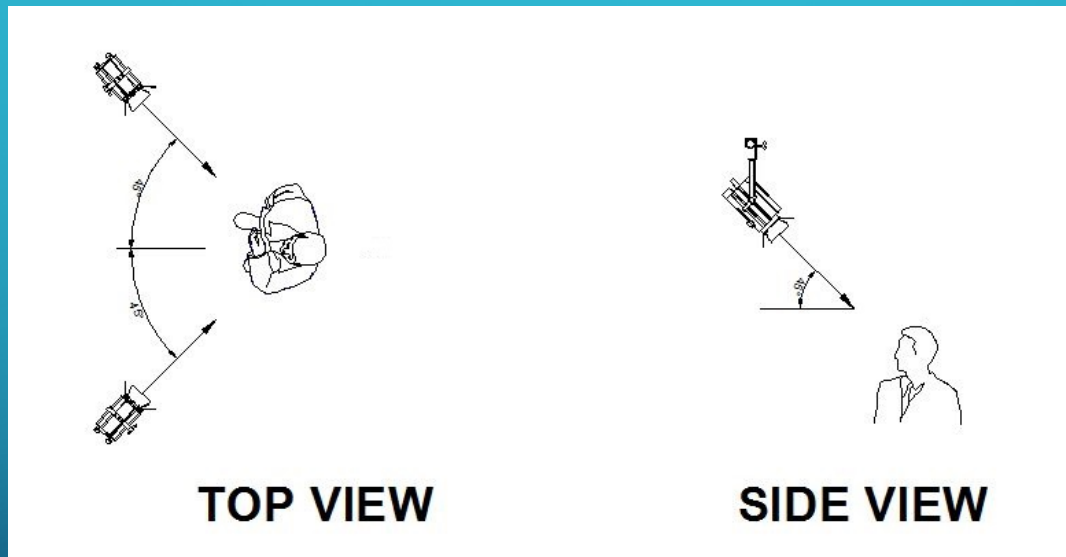| Throw Distance (d)	10' 3m	15' 4.6m	20' 6m	25' 7.6m	30' 9m	35' 10.7m	40' 12.2m	45' 13.7m	50' 15.2m	55' 16.78m
Beam Size Diameter	7.55' 2.30m	11.33' 3.45m	15.10' 4.60m	18.88' 5.75m	22.65' 6.90m	26.43' 8.05m	30.20' 9.20m	33.98' 10.35m	37.75' 11.50m	41.53' 12.65m
Illuminance = fc (Illuminance = lux)	88.00 (947.22)	39.11 (420.98)	22.00 (236.80)	14.08 (151.55)	9.78 (105.24)	7.18 (77.32)	5.50 (49.20)	4.35 (46.77)	3.52 (37.88)	2.91 (31.31)

Note: All measurements are RGBA on at full intensity

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57 Alexander St. Yonkers, NY 10701
Tel: 914-476-7987

ANGLE
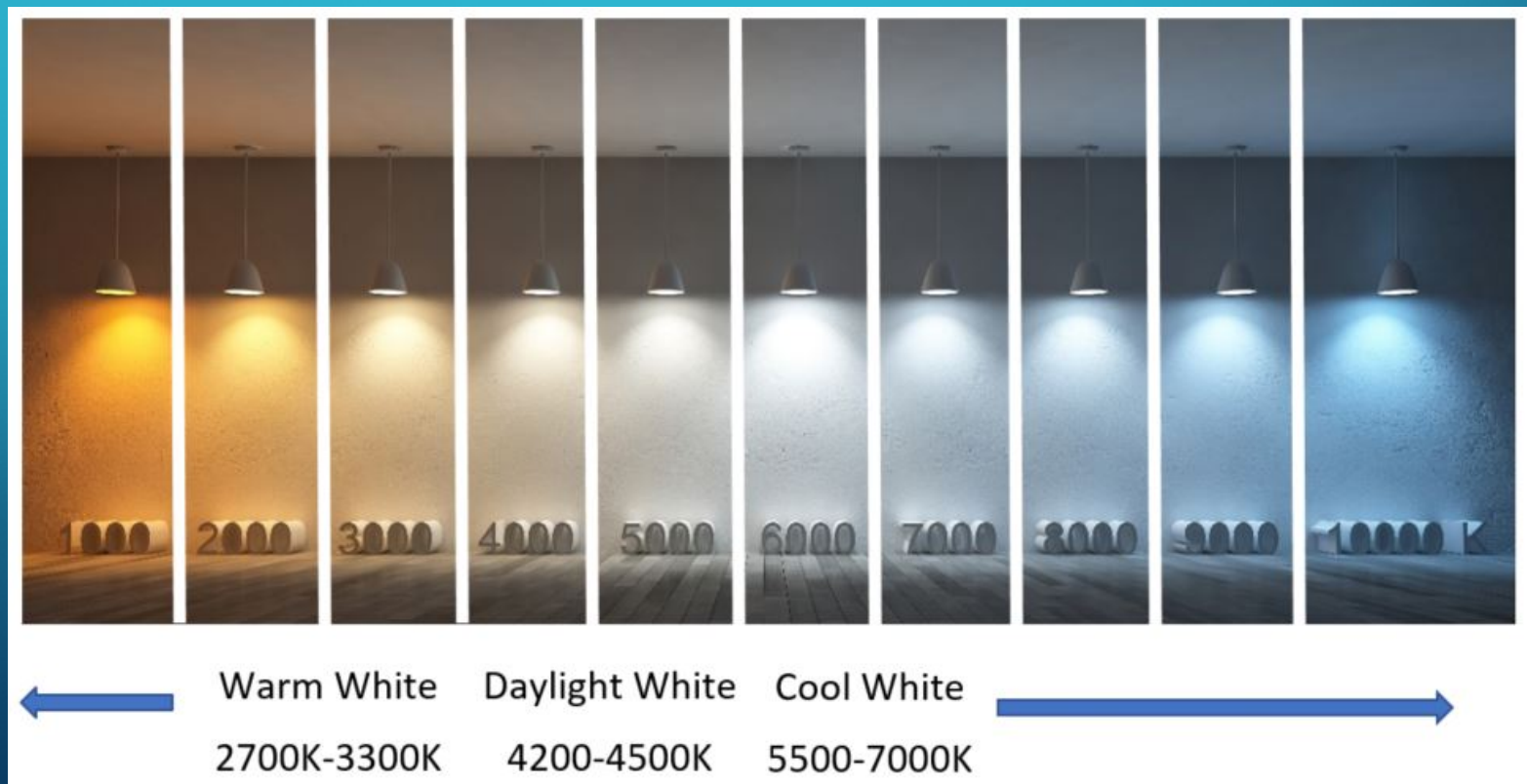## THE ANGLE AT WHICH THE LIGHT IS HITTING THE SUBJECT

TOP VIEW   **SIDE VIEW**

Textbook front light is 45 degrees up and 45 degrees to each side.

COLOR

- Color Temperature is measured in Kelvin

Warm White   Daylight White   Cool White

2700K-3300K   4200-4500K   5500-7000K

COLOR TEMPERATURE CONSIDERATIONS

- Warmer light has a calming effect. A nice restaurant would probably aim for ~2,700K.

- Cooler light is ideal for learning or analysis. Studies recommend ~5,000K lighting in classrooms.

- I tend to avoid using a lot of blue or green around food, especially meat.

DISTRIBUTION

- Where is the light?

- Where isn't there light?

MOVEMENT

- Are the lights themselves moving?

- Are the lights changing?

CONSIDERATIONS

- Eyes are drawn to movement

- Often, but not always, used with music

PUTTING IT ALL TOGETHER

PAR 56 & 64/AL

Altman PARs are low-cost, highly flexible luminaires designed for diverse applications. Intensities and beam spread are a function of the installed light source, so any one unit can serve multiple purposes simply by changing the lamp type.

The smaller size of the PAR56 reduces installation hassles, while the PAR64's optional PAR56/64 adapter ring gives the fixture great versatility. With oval beams and lamp ranges from 300 to 500 watts for the PAR56 and 300 to 1000 watts for the PAR64, these lights are ideal for use in concerts, nightclubs, television and film remotes and architectural applications where maximum flexibility is desired in a small, compact package.

The PAR64-AL is a PAR64 unit constructed from .050-gauge rolled aircraft aluminum to minimize weight without sacrificing durability.
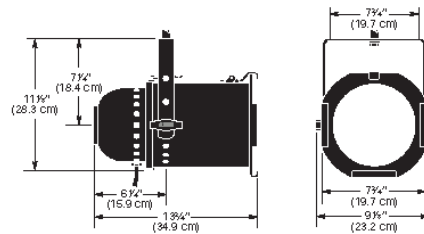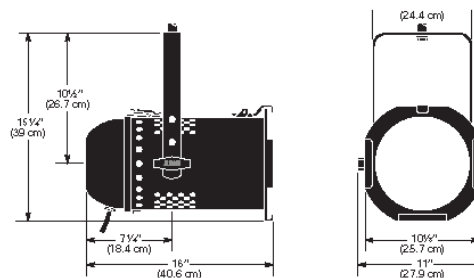
WASH LIGHTING

300-500 WATT   PAR 56
300-1000 WATT   PAR 64 & PAR 64-AL

Features

- Constructed of rugged sheet steel (PAR56/64) or rolled aircraft aluminum (PAR64-AL)

- 360° lamp rotation

- Hinged rear cover for easy lamp access

- Spring loaded accessory holder safety latch

- Mogul-end prong socket

- Three position yoke adjustment

- Three 36" Teflon lead wires

- Color frame, wire mesh safety screen and safety cable with spring clip included.

- U.L. and c.U.L. listed for 500 Watts (PAR56) or 1000 Watts (PAR64/AL)

- Made in the USA

PAR56

PAR64 • PAR64-AL

Model	-	Lamp
PAR64-AL	-	90-300PAR56/NSP

*See following page for lamp data

Project:	Approval Date:
Location:	Fixture Type:

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Specifications:

Materials: Construction employs all corrosion-resistant materials and hardware.

Housing: Spun, rolled, and stamped steel (PAR56, PAR64) or aluminum (PAR64-AL).

Yoke: Rigid flat steel for PAR56 and PAR64, rigid flat aluminum for PAR64-AL.

Socket: Mogul-end prong. Tool free relamping.

Rating: 120/240 volts AC/DC: 4.2/2.1 amps, 500 watts maximum for PAR56; 8.3/4.2 amps, 1000 watts maximum for PAR64 and PAR64-AL.
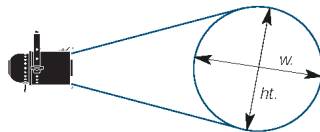
Cable: 36" Teflon leads encased in black sleeving.

Focusing: Lamp can be rotated 360°.

Accessories: Standard 7.5" x 7.5" accessories for PAR56; 10" x 10" accessories for PAR64 and PAR64-AL. Wire mesh safety screen included for PAR56, PAR64 and PAR64-AL.

Finish: Black epoxy sandtex, electrostatic application (PAR56 and PAR64) or brushed aluminum finish outside, flat baked black enamel inside (PAR64-AL).

Weight: Approx. 9 lbs. (4.1 kg) for PAR56; approx. 11 lbs. (5.0 kg) for PAR64; approx 8 lbs. (3.6 kg) for PAR64-AL.

Accessories:

Model Number	Supplied with the fixture
6-CFB	Black Color Frame 7.5"x7.5" (PAR56)
8-CFB	Black Color Frame 10"x10" (PAR64/AL)
SC-36-BK	36" Black Safety Cable w/ Spring Clip
	Additional Accessories
510	Malleable Iron Pipe Clamp for 3/4"-1 1/2" Pipe
6-BD-4	4 door, 8 leaf barndoors (PAR56)
6-SN	Snoot, Black (PAR56)
8-BD-4	4 door, 8 leaf barndoors (PAR64/AL)
8-SN	Snoot, Black (PAR64/AL)
PAR56/64-AR	Adapter ring (for PAR64 & PAR64-AL only)

Lamps:

Watts	ANSI code	Order code	Color temp. (°K)	Rated life (hrs)	Rated lumens	Beam shape	Candlepower (cd)	Beam angle	Field angle
300	--	90-300PAR56/NSP	2800	2000	1,800	NSP	70,000	8°x10°	15°x20°
300	--	90-300PAR56/MFL	2800	2000	2,000	MFL	24,000	11°x23°	20°x35°
300	--	90-300PAR56/WFL	2800	2000	2,100	WFL	10,000	18°x37°	30°x60°
500	--	90-500PAR56/NSP	3000	4000	4,900	NSP	96,000	8°x13°	15°x32°
500	--	90-500PAR56/MFL	3000	4000	5,700	MFL	43,000	10°x26°	20°x42°
500	--	90-500PAR56/WFL	3000	4000	5,725	WFL	19,000	20°x44°	34°x66°
PAR64, PAR64-AL Lamp Information									
500	--	90-500PAR64/NSP	2800	2000	3,000	NSP	110,000	7°x12°	13°x20°
500	--	90-500PAR64/MFL	2800	2000	3,400	MFL	35,000	11°x13°	20°x35°
500	--	90-500PAR64/WFL	2800	2000	3,500	WFL	12,000	20°x42°	35°x65°
1000	--	90-Q1000P64/NSP	3000	4000	8,500	NSP	180,000	8°x15°	14°x31°
1000	--	90-Q1000P64/MFL	3000	4000	10,000	MFL	80,000	12°x28°	22°x45°
1000	--	90-Q1000P64/WFL	3000	4000	13,500	WFL	33,000	24°x48°	45°x72°
1000	FFN	90-FFN	3200	600	11,000	VNSP	400,000	6°x12°	10°x24°
1000	FFP	90-FFP	3200	600	12,000	NSP	330,000	7°x14°	14°x26°
1000	FFR	90-FFR	3200	600	14,000	MFL	125,000	12°x28°	21°x44°
1000	FFS	90-FFS	3200	600	19,000	WFL	40,000	24°x48°	45°x71°

Photometrics:

Distance	10'			20			30			40'			50'			60'		
Lamp	Center beam fc	ht.(')	w.(')	Center beam fc	ht.(')	w.(')	Center beam fc	ht.(')	w.(')	Center beam fc	ht.(')	w.(')	Center beam fc	ht.(')	w.(')	Center beam fc	ht.(')	w.(')
90-300PAR56/NSP	700	2.6	3.5	175	5.3	7.1	78	7.9	10.6	44	10.5	14.1	--	--	--	--	--	--
90-300PARS56/MFL	240	3.5	6.3	60	7.1	12.6	27	10.6	18.9	15	14.1	25.2	--	--	--	--	--	--
90-300PAR56/WFL	100	5.4	11.5	25	10.7	23.1	11	16.1	34.6	6	21.4	46.2	--	--	--	--	--	--
90-500PAR56/NSP	960	2.6	5.7	240	5.3	11.5	107	7.9	17.2	60	10.5	22.9	38	13.2	28.7	--	--	--
90-500PAR56/MFL	430	3.5	7.7	108	7.1	15.4	48	10.6	23.0	27	14.1	30.7	17	17.6	38.4	--	--	--
90-500PAR56/WFL	190	6.1	13.0	48	12.2	26.0	21	18.3	39.0	12	24.5	52.0	8	30.6	65.0	--	--	--
90-500PAR64/NSP	1,100	2.3	3.5	275	4.6	7.1	122	6.8	10.6	69	9.1	14.1	44	11.4	17.6	--	--	--
90-500PAR64/MFL	350	3.5	6.3	88	7.1	12.6	39	10.6	18.9	22	14.1	25.2	14	17.6	31.5	--	--	--
90-500PAR64/WFL	120	6.3	12.7	30	12.6	25.5	13	18.9	38.2	8	25.2	51.0	5	31.5	63.7	--	--	--
90-Q1000P64/NSP	1,800	2.5	5.5	450	4.9	11.1	200	7.4	16.6	113	9.8	22.8	72	12.3	27.7	--	--	--
90-Q1000P64/MFL	800	3.9	8.3	200	7.8	16.6	89	11.7	24.9	50	15.6	33.1	32	19.4	41.4	--	--	--
90-Q1000P64/WFL	330	8.3	14.5	83	16.6	29.1	37	24.9	43.6	21	33.1	58.1	13	41.4	72.7	--	--	--
90-FFN	4,000	1.8	4.3	1,000	3.5	8.5	445	5.3	12.8	250	7.0	17.0	160	8.8	21.3	111	10.5	25.5
90-FFP	3,300	2.5	4.6	825	4.9	9.2	367	7.4	13.9	206	9.8	18.5	132	12.3	23.1	92	14.8	27.7
90-FFR	1,250	3.7	8.0	313	7.4	16.2	139	11.1	24.3	78	14.8	32.3	50	18.5	40.4	35	22.2	48.5
90-FFS	400	8.3	14.3	100	16.6	28.5	44	24.9	42.8	25	33.1	57.0	16	41.4	71.3	11	49.7	85.6

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BRINGING IMAGINATION TO LIGHT

Photometrics:

Distance	10'			20			30'		
Lamp	Center beam fc	ht.(')	w.(')	Center beam fc	ht.(')	w.(')	Center beam fc	ht.(')	w.(')
90-300PAR56/NSP	700	2.6	3.5	175	5.3	7.1	78	7.9	10.6
90-300PAR556/MFL	240	3.5	6.3	60	7.1	12.6	27	10.6	18.9
90-300PAR56/WFL	100	5.4	11.5	25	10.7	23.1	11	16.1	34.6
90-500PAR56/NSP	960	2.6	5.7	240	5.3	11.5	107	7.9	17.2
90-500PAR56/MFL	430	3.5	7.7	108	7.1	15.4	48	10.6	23.0
90-500PAR56/WFL	190	6.1	13.0	48	12.2	26.0	21	18.3	39.0
90-500PAR64/NSP	1,100	2.3	3.5	275	4.6	7.1	122	6.8	10.6
90-500PAR64/MFL	350	3.5	6.3	88	7.1	12.6	39	10.6	18.9

Opti Tri Par

Opti Tri Par Dimensions

10.6" / 269.3mm
14.80" / 375.94mm
14.81" / 376.2mm
9.5" / 240.9mm
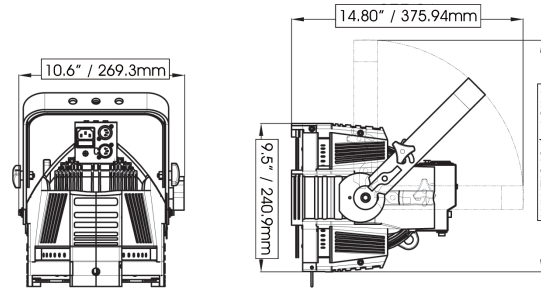
The Opti Tri Par by Elation Professional is a RBG tri color LED par featuring 18 tri RGB running at 3W power each. The design of the fixture is optimized providing up to 50,000 hours estimated LED life, 70W power consumption, fan cooled and flicker free operation. The Opti Tri Par is operable via 6 DMX channel modes: 1, 2, 3, 4, 6, and 7. This unit produces a standard beam angle of 25° and is rated IP 20, ideal for indoor applications. Control data input is via 5 pin DMX data first in and out connections. This unit is fully operational in any mounting position. Other features include electronic power supply, five operating modes and user may daisy chain units together in DMX mode. Gel frame is included and rigging for this unit includes single yoke bracket, safety and data cable are optional.

FEATURES

- Tri-Color LED Par
- ETL Approved Fixture
- DMX intelligent 3-in-1 RGB LED wash
- 18 x 3W LEDs
- 25° standard beam angle
- Rated IP 20
- Case Color: Black
- Cooling: Fan Cooled
- Electronic power supply
- 4 Digit LED display
- DMX controllable via 6 DMX modes: 1, 2, 3, 4, 6, & 7
- Macros: Yes
- Gel Frame Included
- Master/Slave
- On Board Control
- Stand Alone
- Flicker Free

TECHNICAL SPECIFICATIONS

- **DMX Channels:** 6 DMX modes: 1, 2, 3, 4, 6, & 7
- **Control:** USITT DMX-512, 5 pin XLR data input & output
- **Dimmer:** Master Dimmer (7 ch mode)
- **Strobe:** Strobe effect (1-18 flashes per second)
- **IP Rating:** IP 20
- **Power Supply:** 90 - 240v, 50/60Hz
- **Power Consumption:** 70W
- **Ballast**: Electronic
- **Cable / Plug Type:** PPG 120v US
- **Approvals:** CE Approved - ETL Approved
- **Lamp:** SSC-Tri RGB, 18 x Tri RGB, 18 x 3W LEDs
- **Lamp Life:** 50,000 hrs. life
- **Lux:** 350 Lux @ 3M
- **Dimensions:** (LxWxH) 11.5" x 8.5" x 8.5" / 292.1 x 215.9 x 215.9mm
- **Weight:** 11 lbs / 4.9 kg
- **Rigging:** Split Yoke Bracket / safety and data cable optional
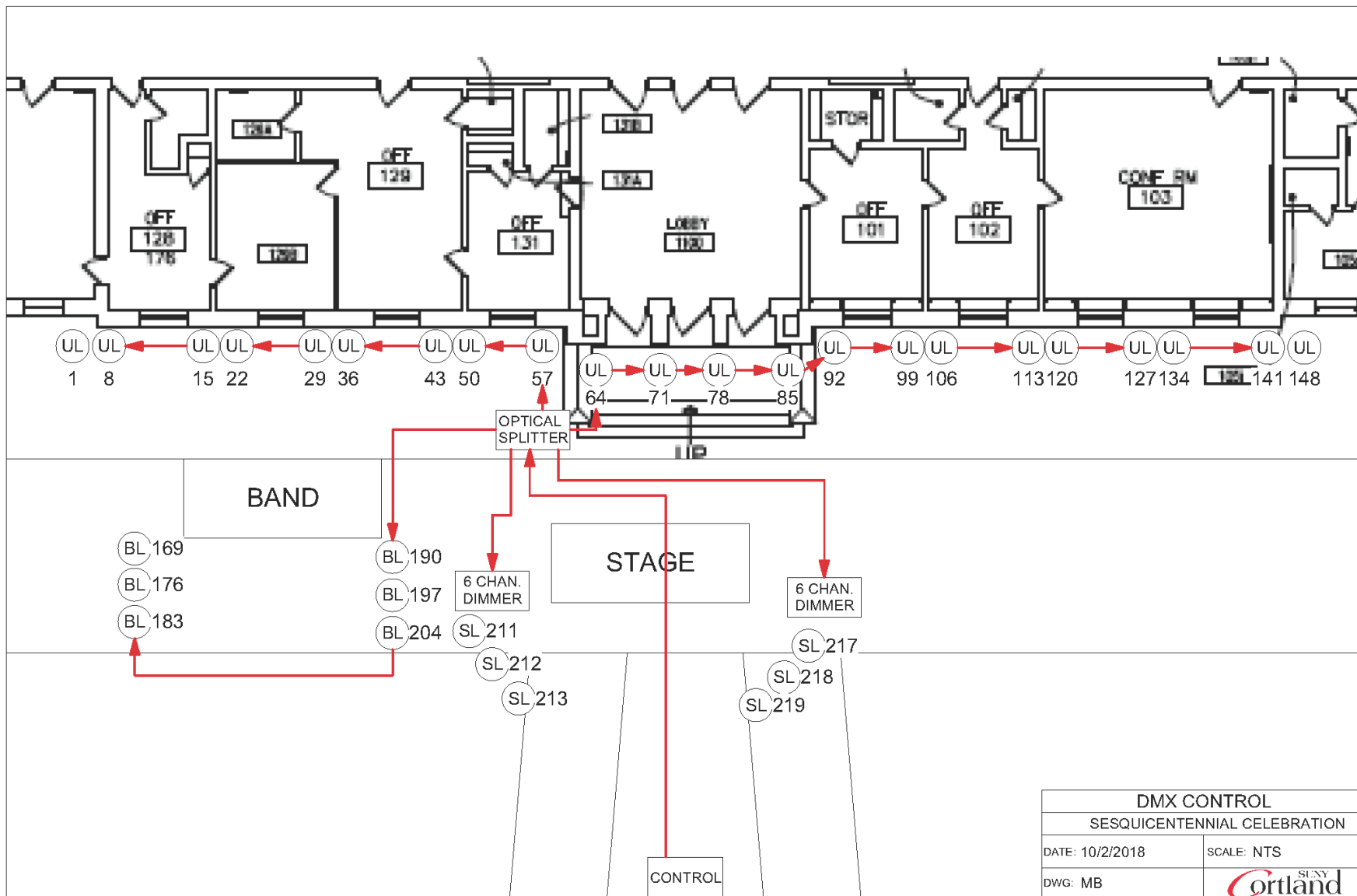
SYSTEM SETUP

- Control Protocols
    - DMX
    - Art-Net, sACN

- Controllers

- Dimming

- Power

DMX CONTROL

- Initially developed to standardize control of dimmers

- Based on RS-485

- Unidirectional – no feedback from fixtures

- One DMX Universe contains 512 channels, each can have a value of 0-255

- Fixtures or dimmers are addressed with a channel which they will respond to
  - This is a "start" channel, but devices will typically use more than one channel

- Daisy-chainable, no Y cables
  - The only way to split a DMX signal is with an optical splitter

- Max ~1,000 ft total run, ~300 feet between devices

OFF 130

OFF 129

STOR

CONF RM 103

OFF 128
178

OFF 131

LOBBY 100

OFF 101

OFF 102

BAND

STAGE

UL 1 UL 8   UL 15 UL 22   UL 29 UL 36   UL 43 UL 50   UL 57

UL 64   UL 71   UL 78   UL 85   UL 92   UL 99 UL 106   UL 113 UL 120   UL 127 UL 134   UL 141 UL 148

OPTICAL SPLITTER

BL 169

BL 176

BL 183

BL 190

BL 197

BL 204

6 CHAN. DIMMER

6 CHAN. DIMMER

SL 211

SL 212

SL 213

SL 217

SL 218

SL 219

CONTROL

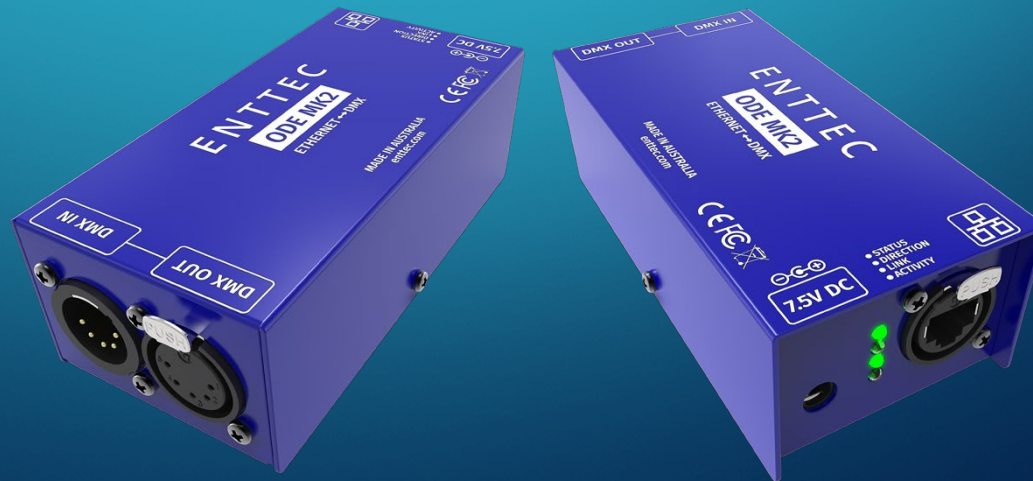| DMX CONTROL	
SESQUICENTENNIAL CELEBRATION	
DATE: 10/2/2018	SCALE: NTS
DWG: MB	SUNY Cortland

DMX OVER ETHERNET

- Art-Net
    - Control up to 32,768 DMX universes over Ethernet
- sACN
    - Control up to 63,999 DMX universes over Ethernet
- Some fixtures will directly connect via Ethernet and can use these protocols, but typically a node is used.

DMX CONTROLLERS

- Consoles
  - Professional
    - Theatrical
      - ETC, Strand
    - Concerts
      - High End Systems, MA Lighting, Martin, Chamsys.
  - DJ
    - Elation, American DJ, Chauvet
- Apps
  - Luminair, Aurora DMX

Luminair App

ETC Element 2

DIMMING

- Incandescent fixtures are controlled using dimmers.

- DMX and power input, variable power output.

- Commonly available from 1 channel to 96 channels.

Elation Uni-Bar
Single Channel

Leprechaun ULD-360
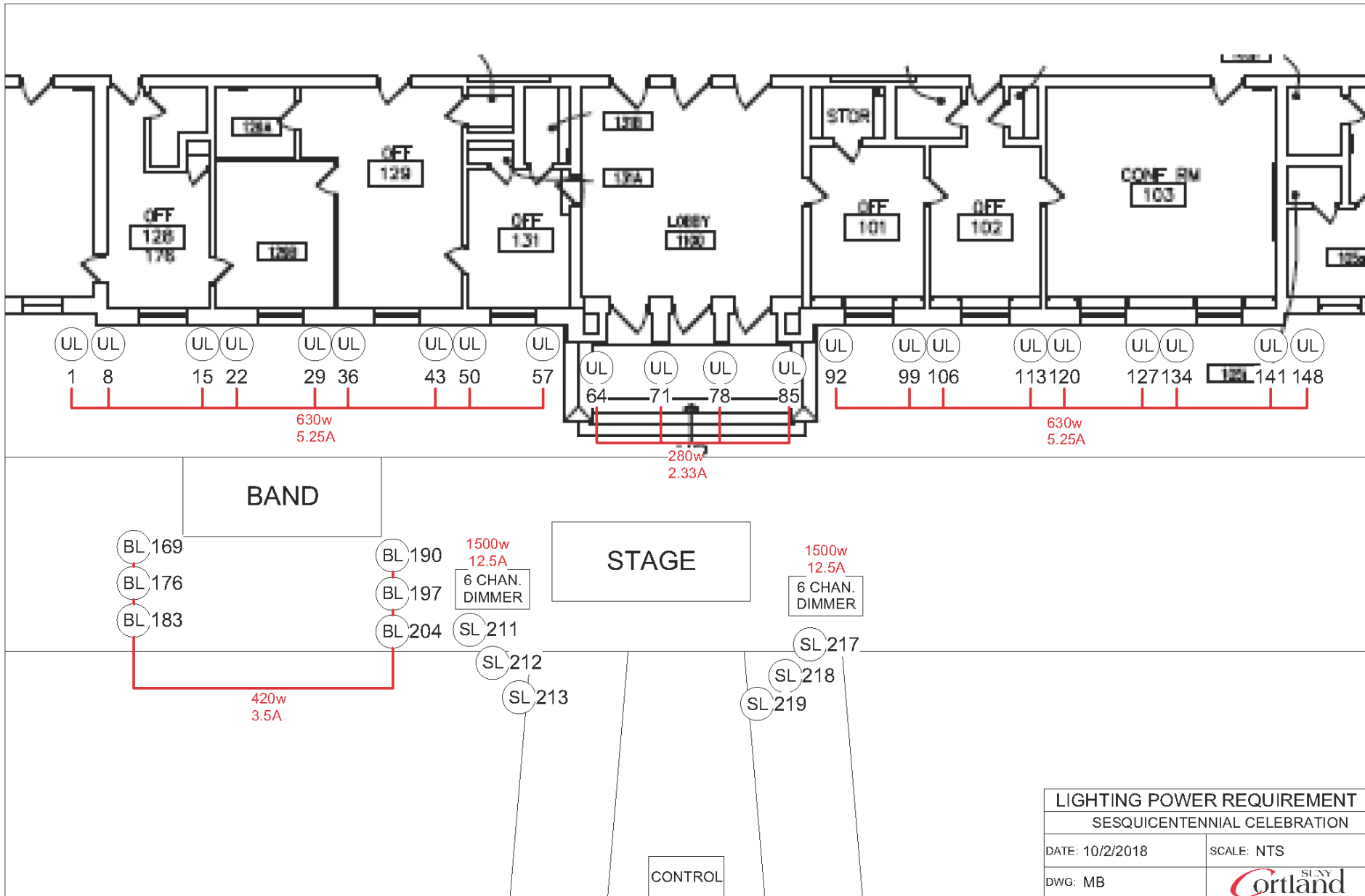6 Channel

ETC Sensor3
48 Channel

POWER

- Incandescent lighting uses a lot of power
    - Par Cans from earlier = 500 watts each
    - 500 x 4 = 2,000 watts

- Typical 20 amp branch circuit should not see a constant load more than 80%

- 20 amp @ 120v = 2,400 watts. 80% x 2,400 watts = 1,920 watts max.

- LED is much more efficient, but you still must be careful.

POWER, CONTINUED.

- Extension Cords

  - "Cheap orange" cords often 16 gauge.

  - 16 gauge typically rated 10 amps

  - 14 gauge typically rated 15 amps

  - 12 gauge typically rated 20 amps

- Derate with distance

OFF 129

OFF 128
176

128B

128A

OFF 131

130B

130A

LOBBY 130

STOR

CONF RM 103

OFF 101

OFF 102

125a

UL 1 — UL 8 — UL 15 — UL 22 — UL 29 — UL 36 — UL 43 — UL 50 — UL 57

630w 5.25A

UL 64 — UL 71 — UL 78 — UL 85

280w 2.33A

UL 92 — UL 99 — UL 106 — UL 113 — UL 120 — UL 127 — UL 134 — 126 UL 141 — UL 148

630w 5.25A

BAND

STAGE

BL 169

BL 176

BL 183

BL 190

BL 197

BL 204

1500w 12.5A

6 CHAN. DIMMER

SL 211

SL 212

SL 213

420w 3.5A

1500w 12.5A

6 CHAN. DIMMER

SL 217

SL 218

SL 219

CONTROL

LIGHTING POWER REQUIREMENT

SESQUICENTENNIAL CELEBRATION

DATE: 10/2/2018

SCALE: NTS

DWG: MB

SUNY Cortland

COST CONSIDERATIONS

VERY ROUGH BUDGET PRICING FOR 2-3 DAYS RENTAL

- LED LIGHTING FIXTURES WIRED/WIRELESS BUDGET $35/EACH

- CABLES $5/ EACH

- CONTROLLER $100-$200

ACTUAL COST – SUNY CORTLAND SESQUICENTENNIAL

- WIRED PACKAGE (28 LIGHTS, CABLES, TAPE, ETC, NO CONTROLLER = $1,150

- WIRELESS PACKAGE (30 LIGHTS) = $690

TOTAL = $1,840

QUESTIONS?