**22’ TOS USS ENTERPRISE "Cut-away" Model, ERTL/AMT # 8790**

**Modification Goals:**
- Assemble as a completed model
- Correct Bridge and upper deck levels
- Replace split Warp Engine front Dome (Part 100)
- Replace Shuttle Bay control Room and Fantail Shuttle Bay Doors
- Replace Warp Field Enhancement Grills

**Accurate Replacement Resin Detail Parts:**
1. Upper Levels Deck and Command Bridge (1)
   (Opaque Gray Resin if Non-lighting)
2. Planetary Sensor Dome, clear (1)
3. Planetary Sensor Array Ring (1)
4. Warp Engine Aft End Caps (2)
5. Final Stage Flux Chillers (3)
6. Intake Sink Field Generators (6)
7. Shuttle Bay Doors and Control Room (1)
8. Impulse Engine housing replacement (1)
9. Warp Field Enhancement Grills (10)
10. Warp Engine front Dome
11. Final Stage Intercoolers
12. DLM Waddell Warp System Board and Warp Engine Discs (Included only in Lighting Option)

**Lighting Features Instructions:**
- Ports and Windows lighting with incandescent lamps or white LEDs
- Flashing Navigation running lights (Red, Green and White LEDs)
- Rotating Warp Engine Effect with 16 Red, Orange and Yellow LEDs in each Nacelle
- Illuminated Panels on top of hull
- Illuminated Bridge and Lower Sensor Array Domes
- Illuminated Navigation Beacon (Bulb)
- Flashing Ion Pod Sensor (white LED)
- Lighting Operating System used: DLM Waddell Warp System Board

**Recommended Paints Used with Project:**
- Model Master colors
- Tamiya Clear Acrylics
- Markings and Decals DLM TOS Decal Sheet, JT Graphics and Thomas Models.

**References:**
- Star Fleet Assembly Manual #3 Paul M. Newitt
- Constitution Class Assembly Manual-TOS 18”: Donald L. Matthys
- Famous Spaceships of Fact and Fantasy, Edited by Harold Edmonson, Kalmbach books 1979
- Article "Smithsonian Report", Star Trek Giant Poster Book, SD 7706.01 by Doug Drexler
- Article: "Restoring the Enterprise", Star Fleet Communicute April 1993, by Lynne Miller
- Article: "The Starship Enterprise" Color and Camouflage Special, Fine Scale Modeler February 1998 (Charles Adams)
- Decal Placement Instructions and Plans by “Decalex” Designed by Shane Johnson
- TOS EnterpriseTech Specs by Thomas Sasser
- Smithsonian Photo Collections by Lonnie Misner, Nick Vellesenko, Peter Saven, William Mccullers, Charls Adams, John Cullum, Mike Emyer of LightSheet

**World Wide Web Sites to view the original studio models:** (Smithsonian exhibit and DS:9 Episode model)
- http://members.aol.com/IDICPage/main.html (William Mccullar's IDIC Home Page)
- http://www.shiporama.org (Peter Savon; Pedros Shiporama)
RESEARCH ON PROJECT "HOME WORK FROM SCOTTY"

Initially information on the 14 ft. Studio Miniature came by very piece meal. The best resources I had when this project started is an article in the Star Trek Giant Poster by Doug Drexler and the Kalmbach modeling book "Famous Spaceships of Fact and Fantasy". The pictures in these publications show the model at its first restoration at the Smithsonian's Silver Hill Maryland facility and on display at the Air and Space Museum for most of the 1970s and 80s.

A second restoration had to be done by 1991 for a major Star Trek exhibit at the Air & Space Museum. Enter Ed Miaerccki, a prop maker for ST: TNG, he accompanied Michael Okoda, the series art director, to a Star Trek convention in Maryland. During a lunch Okoda introduced Ed to Ken Isbell of the Smithsonian. During which Ed made the off the cuff comment "When are you going to restore the Enterprise?" Thus starting a series of discussions which resulted into a contract to restore one of the most famous television props in history.

After Ed presented his credentials to the curator at the Smithsonian and inspected the model, it was shipped covertly to Ed's workshop in Springfield, Massachusetts and delivered in the dead of night from a huge step van. Only a few people knew of the restoration and a security system to the shop was installed. The ship was pretty well beat up from 25 years of neglect and abuse. After the series was canceled the model sat in the Paramount prop department for years until groups of college students used it at "Trek" parties. The Smithsonian obtained it in very poor condition in 1974.

Ed started into the project, he first consulted with Matt Jeffries the old series Art Director and Homer Jensen one of the builders for the Howard Anderson company. Homer was 82 years old when interviewed but managed to remember back 27 years. With information and film clips, the assembled crew of local modelers with the assistance from a crew from California started in. "The whole project was a dream come true, and a lot of fun," Miarecki said.

Ed started by taking it apart and inspect it to see how it was constructed, and to gather information on original paint colors. Most of the model is constructed of wood like a piece of furniture. The only major plastic piece is the primary hull which was vacumm formed and fitted to a wooden frame. After the model's "superstructure" was rebuilt, an all new electrical/electronic system was installed by an electronics team then new paint was applied and "weathered" to the conditions filmed in the series third and final season. The Smithsonian exhibit opened on Feb. 28, 1992 to the public. Their are no plans to restore it for another 50 years so Ed Miarecki's accomplishments will have to stand for some time. The model went on tour for a while to Smithsonian sponsored exhibits. The studio is now on perminant display near the gift shop of the Air and Space Museum.

The "Decalex " decal placement plans designed by Shane Johnson provides the most correct information of the placement of ports and windows done for a decal sheet for the smaller AMT issued model kit. His placement of ports and windows corresponds to the photos of the Studio Miniature located at the Smithsonian. Continued observation of the provided kits placement of ports and windows on the Dorsal and the Engineering Hull is convincingly close to the Studio Model. The Thomas Models Tech Specs were another accurate source of drawings. With the plans enlarged to 123% the Tech Spec plans are pretty accurate.

(They plans provided in this resin upgrade kit is for the DLM decal sheets. When enlarged up to 171% this reference will be a valuable asset as far as proper placement of ports and windows onto the 22" TOS Cutaway model upgrade.)

News about the availability of markings and decals. Aftermarket decals have been made from the following sources:
Don's Light and Magic: Don Matthys
JT Graphics

**Construction Notes:** Recommended construction procedures of the model.

- Cement Primary Hull parts together.
- Reinforce seam weld with Superglue (Inside)

Comparisons of the 14 ft. miniature to the new ERTL/AMT kit show that the teardrop shape of the upper decks to be correct from the top view. From the front and side views its height is to shallow (approximately 1/16 inch) and the bridge is to tall (by 1/16 inch). It is slight but noticeable. This upper deck and bridge is the first thing to replace.

**PRIMARY HULL CORRECTIONS: TOP PIECE**

- With a thin razor saw. Cut the kits upper tear dropped shaped area from the side being very careful to cut right at the edge where it meets the main hull.
- This area is then sanded flat to remove the rough edges from the removed plastic.
- Remove excess resin sprue from the upper decks corrective part.
- File and sand the edge of the cut kit plastic smooth and finally fit the new resin part until the mitered edged lip fits back into the kit plastic.
- Test fit often, Superglue or epoxy into place, and let it set up.
- Use a epoxy putty or any other model putty to fill the gaps between the top Primary Hull and resin replacement parts for upper decks.
- With the Epoxy putty fully cured start doing the final shaping and smoothing of the seam with wet/dry 150 or 220 grit Aluminum Oxide sanding papers. Give a final smooth-out with 400 grit sand paper.

The new resin part’s contours and height now look correct to the configurations of the studio miniature. The upper decks above the Primary Hull have been raised 1/16th inch and the Bridge Dome shortened in height a bit with a clean looking projection of the Turbo lift Elevator cylinder sticking from behind the Bridge. Now further modifications on the upper piece of the main hull can begin. (The example shown left is for the 2nd Pilot Episode Upper Decks and Bridge.)

- Putty in the “L” shaped panels at the rear of the hull and the remaining gaps of the “cutaway” seams.

**LIGHTING OPTION:** Open up the four rectangular panels located at 45, 135, 235, 315 degrees. This will be replaced with Evergreen .020 white sheet plastic. Punched right through with an Exacto #17 chisel point blade. These panel areas will glow white when the model is lit up.

- Drill and or ream out to size the three navigation lights located as bumps on the kit to fit a modified T-1 type LED. Make sure the "mounting ring" of the Navigation Running Lights remains intact.

The upper piece of the primary hull has now gotten an accurately shaped Bridge and Upper Deck Levels. The clear resin option part will allow light the shine through in masked ports and windows. Four panels are opened up that will also allow light to shine through and the Navigation Running Lights now have holes to accommodate LEDs lights. The next piece to work on is the Primary Hulls lower part.
PRIMARY HULL CORRECTIONS: BOTTOM PIECE (With Lighting Options)

The placement of lighted ports and windows uses references from the following sources:

• Famous Spaceships of Fact and Fantasy, Edited by Harold Edmonson, Kalmbach books 1979
• Article “Smithsonian Report”, Star Trek Giant Poster Book, SD 7706.01 by Doug Drexler
• Decal Instructions and Plans by “Decalex” Designed by Shane Johnson,
• Thomas ModelsTech Specs by Thomas Sasser

The AMT kits rounds ports and rectangular windows is not correct. Their placement seam random and inaccurate. Here is the procedure for corrections:

The DLM plans provides a reference for the placement of the round Ports, Windows, decals and markings. These placements check out well with pictures of the 11 ft. studio miniature at the Smithsonian. The decal sheets plans should be enlarged 171% to fit the dimensions of the 22" kit with a copier machine done at a local graphics service center. More sections are copied from the enlarged plans and transcribed to the location of the model. First cut or punch out the windows on these paper templates. A spray adhesive can be sprayed onto the back of the cut out templates to temporarily adhere to the kit.

Remember to employ a little geometry before attaching paper window templates to the model. With the use of drafting tools, triangles and a “T” square, project the side views which displays all the ports and windows to the front view. Then a correct measurement can be made to the template using the 90 degree angle as a point of reference above and below. The paper copies used as a template can be cut into strips and positioned onto the Secondary Hull.

With all the paper templates fastened, an air brush loaded with a gray paint was sprayed onto the the cut opened areas of the ports and Windows of the paper template. With the area marked by the pigment and let to dry, remove the paper template masks.

With a Walthers #70 fine drill bit and a Dremel Motor Tool the start opening up the windows. Drill the four corners of the horizontal windows within the spray marked areas. Drill the middle between the corners inside as well. Next with a sharp # 11 Exacto blade cut through each of the windows and remove much as the material as possible. The next tool to use is a Dremel # 65 burr to clean up the opening. The final measure was with a small miniature needle file to further clean and refine the opened up windows. Precision is desirable but not required. After these holes are filled with clear resin and sanded smooth the sharpness of the windows will finally be defined by the masking tape pieces used in the final stages of opaque masking, priming and painting.

LIGHTING OPTION PROCEDURE
• Putty in all of the indented retangular windows on the bottom and the sides of the kits lower hull piece. Sand smooth.
• Open up the dorsal connector area of the Primary Hull to accomidate electronic wiring harness.
• Putty up the kit windows.
• Transpose the Plans to the kit: A drafting compass and dividers can be used to draw the locations after establishing a true centerpoint on the kits bottom Sensor Dome. Photo copies of the blown up plans will provide a template to correctly place the ports and windows. A #70 fine drill bit was drilled into the rectangular windows after which an Exacto blade removed the bulk of the material, followed by a small Dremel tool burr. Finally squared off shape was finished with a small square jewelers file.

PRIMARY HULL LOWER PART DETAILS:
The raised pane lines and triangular panel shapes are filled and sanded smooth. Next with a scribing tool attached to a bow compass the circular lines where etched back in. Now that these round lines are etched into their proper location the kits Lower Planetary Sensor Dome can be
removed and replaced with the more accurate resin cast DLM part and the clear cast plastic hemisphere dome.

**Secondary Hull Preparations**

At this point, remove the interior “Cut-away” aspects of the kit from the Secondary Hull parts. The left side of the hull should be now glued together resulting in two separate halves. With the ports and windows opened and cleaned up the major components of the kit is now ready for opaquing.

**Opaqueing the Hulls:**

To prevent the emissions of unwanted light leaks from the kit plastic it is important to opaque paint the interior of the hulls when light sources will be used inside the model.

• With a black paint and an airbrush, paint the interior with a thick coat of black. With a single source of light in a darkened room you could check for uneven coverage and reapply the black paint. Let this dry for a while.

Next with a white paint in the airbrush the interior was once again painted. The purpose of the white is to increase the reflection of light photons inside the model ship to bounce around and go out the ship where you want it. (Like the windows, ports, domes and panels etc.) Set this side to dry.

It is important to note that paint on the kits glue joints should be scraped and cleaned away from the kit plastic for a better bind in glueing.

The illuminated panels on top of the Primary Hull had small pieces of Evergreen .02 sheet stock installed. The panels were fitted to fit flush with the hull cutouts. The panel was also allowed to stick up a little ways on the exterior of the hull. Fill any gaps with putty and sanded smooth level to the hull tops exterior.

**Making Clear Windows and Ports**

The next procedure is how to fill in lighted ports and windows with a clear resin and fiber optics. At this point the kit has been painted with a black paint to opaque the light from shining through the kit plastic and then painted again with white to maximize the reflection of light within the ship.

Once again a check of the opened up rectangular window should be made to remove any plastic debris in left in these openings.

Next with a transparent ‘magic’ tape like one made by 3M was placed on the exterior of the ship to hold the clear casting resin. The clear resin I use is “Envirotex” which is a clear two part liquid mixed together in equal parts. It is primarily used for decopage and as a thick clear coating over wood with a thick gloss finish. It can be found in many hobby and craft stores. A similar product called “Ultra-Glo” will work the same and is available from Micro-Mark tools. Its use is intended as a clear media to simulate water in model railroad dioramas.
Mix up a small batch of the resin and be careful to gently stir it to avoid making air bubbles. With a toothpick's end point pick up some of the resin and let it flow into the open window. Check to see if any air bubbles are in the cavity and if there is poke a small hole through the tape with a fresh sharp #11 Exacto blade and let the air bleed out. Set the part aside on an even surface so the resin can harden in place. You can only do this in sections as the resin will flow out and make a mess. In several hours you can fill another section. This process may take several days.

The resin is fully cured in about 24 hours. Then you can remove the tape from the exterior and it then can be filed and sanded smooth.

For the circular ports use a thick fiber optic of .060 diameter. Cut it into small 1/2 inch long sections and then flare one end with a heat source like a soldering iron. Stick the clear piece of rod into the hole and Superglue in place on the inside of the ship. You will have a bump of clear plastic on the surface. Then sand it flush and smooth with the exterior surface of the model starship.

With these procedures done, light will now emit out where you want it. This procedure can be used on any spaceship miniature that you wish to light up. You can also color the window with any of the Tamiya clear acrylic paints or darken the window light emission with Tamiya's Smoke colored window tint.

**LIGHT EFFECTS:**

**Fiber Optics Resources:** This model plastics firm has an extensive source of plastic materials for modelbuilding:

Plastruct
1020 South Wallace Place
City of Industry, CA 91748
(818) 912-7016 You can order online at: [www.plastruct.com](http://www.plastruct.com)

Plastruct provides many of the components that can be used on the Enterprise project. Some of the stuff that can be used is clear hemispherical domes, elliptical domes, spheres, clear acrylic rods and fiber optics up to .060 mils.

**Electronics Components source:** A good source for LEDs, IC chips, and other electronics is Radio Shack but a better source by mail order at Digi-key Corporation. This is a good source of white LED's IC chips and resistors. Radio Shacks are a good source for power supplies that will convert household current to 6 volts at 800mA to power the model. Also wire ribbon cables and soldering equipment.

Digi-key Corporation
701 Brooks Ave. South
Thief River Falls MN 56701- 0677
www.digikey.com 1-800-344-4539

They will take phone orders and accept all major credit cards. They carry all of the electronic parts needed to outfit the WWB board and LEDs. If you wish to use, small Grain Of Wheat (GOW) bulbs that run at 6 volts DC are the best buy when ordered from Walthers Model Railroad Supply. Their selection is quite large. The best lamps to use are made by Scale Shop at four to a package for around a dollar a pack. Most hobby shops handling
model railroad stuff will have a Walthers supply catalog and your hobby shop can order them for you.


The DLM Waddell Warp System provides modelers with four distinct functions: Blinking navigation lights, a rotating Warp Engine effect, Ion Pod strobes & incandescent interior lighting.

**Interior Lighting:**

6V, 25ma grain of wheat (GOW) lamps provide interior lighting for the ship's ports and sensor domes (up to a maximum of five in the Primary Hull, 4 in the Engineering) connected directly form the 6V power supply.

3.5v 30ma White LEDs, 5mm diameter, can be substituted for GOW filament lamps. Add a 80 to 100 Ohm resistor to the positive side of the LED. This will allow the white LED to operate at 6 volts DC. A good LED with a wide viewing angle of 70 degees. You can buy this LED from LEDSupply.com (http://www.ledsupply.com/l1-0-w5th70-1.php)

**Navigation Lights:**

One half of the 556 dual timer (U2) drives the blinking running lights at a rate determined by the combination of resistors R1, R2, R3 and capacitor C2. R3 is a 10k potentiometer which allows the modeler to adjust the rate to suit their own perception. The total resistance of R2 + R3 (i.e. the resistance measured from pins 13 to 8 on the 556) to be approximately 6k to 7k ohms of resistance, based on the opening sequence of "The Tholian Web". Modelers who possess a voltmeter/ multimeter can use that value as a starting point. The output of the 556 is through pin 9 and directly drives the four LEDs through 270 ohm resistors. Note that the orientation of the leads of the LEDs is critical: the (+) positive lead must connect to the 270 ohm resistor while the negative lead connects to ground.

**Ion Pod Strobes:**

U1, a 555 cmos timer, is specifically designed to blink Light Emitting Diodes. The rate of flashing is determined by the value of the electrolytic capacitor C1, and the value chosen exactly matches that of TOS Enterprise as shown on TV. Note that some electrolytics capacitores have very broad tolerances (Hence a cap marked as 47uF could actually have a value anywhere between 100 and 150uF if the tolerance rating is 20%) so some experimentation may be necessary. The outputs of the U1 555 chip are pins 6 (+ve) and 3 (-ve) and can drive a maximum of four white LEDs.

**Warp Engine Effect:**

The DLM Waddell Warp System is a 3-step chaser sequence which provides two additional "spokes", thus enhancing the illusion of a rotating shutter.

The timing of the rotation is driven by the other half of U2 and set by the resistors R8, R9, R10, and the capacitor C3. The 556 is essentially a dual 555 timer, and acts here as an astable oscillator (same as the running lights) which means that it triggers itself and runs free as a multivibrator. A 50k potentiometer (R9) varies the rotational rate from a slow crawl (cracked dilithium crystals) to almost steady on (warp 10, perhaps). Modelers should experiment with the timing to achieve the desired illusion (Use a starting point of 46-47k total resistance between R9 and R10, or between pins 1 and 2 of the 556). The output of the 556 is through pin 5 which connects to the clock input of the 4017 (pin 14). Although the 4017 is a decade counter (i.e. from 0-9), it is only using the first three outputs (pins 3, 2 & 4 correspond to 0, 1, 2) by shorting out the next output (pin 7) to pin 15 (reset). Each of the three outputs connect to the base of a 2N2222 power transistor through a 1k resistor. The emitter connects to ground while the collector is tied to the positive lead of 5 T1 LEDs on each side (a total of 10 LEDs per output). DLM has produced warp nacelle disks that greatly simplify the wiring of the LEDs while also insuring they are connected in the right order (0-1-2) to rotate inwards (i.e. the starboard side rotates clockwise as viewed from the front, while the port side rotates counter-clockwise). To complete the effect, a centre T1 LED is always on and the +ve lead is connected to +5V while the negative lead is connected to ground through a 270 ohm resistor.

It is a common misconception that TOS Enterprise's warp lights were all red; in fact, they were multi-coloured Christmas tree lights. DLM recommends the use of different colour LEDs (yellow, orange, red for example) for the ring of lights while the centre LED should be red for colour balance. Again, the modeler should experiment with different permutations to satisfy their own vision of the warp effect. Also, the modeler can play with the brightness of the nacelle LEDs by connecting 100-270 ohm limiting resistors to the individual negative leads (0, 1, 2).
Construction of the Special Effects Circuit Board will consist of the following steps:
1. Acquiring and checking all parts and tools to be sure all materials are at hand before beginning building.
2. Assembling and soldering the board circuitry.
3. Preparing and attaching all wires to the board.
4. Adding the LEDs (Light Emitting Diodes)
5. THIS IS VERY IMPORTANT: Power up the board and checking that it is fully functional. Let it run for a while, stop and start it several times. You want to find any problems like a bad connection or missing part BEFORE installing it in the model ship.

Read ahead at this point and familiarize with the materials and assembly procedures discussed on the next few pages before beginning actual construction.

Tool list (Electronic Construction)
• Small "Thin Nose" pliers (also acceptable: “Chain Nose” or “Needle- Nose” pliers)
• Soldering iron with pencil tip (25-30 watt iron acceptable)
• Wire strippers/cutters
• Safety goggles or face shield for eye protection during soldering
• Small diagonal cutters (nail clippers acceptable)
• Super Glue
• Rosin core solder, 22 or 20 gauge

Wire Harness and Lamps
• Computer ribbon cable 1 1/2 ft. - 25 conductor flat
  (25 Conductor Split 1/2, Radio Shack)
• 5 ft. - 26 Gauge stranded, twisted pair wire
• 10 - 6 volt, 20 milli-amp incandescent lamps with leads (Walthers 942-441) (Scale Shops 649-5001)
• Or use White LEDs with 80 to 100 Ohm limit resistors.
• Power Plug (Adapter-miniature to power Plug)
• Power Jack (2-conductor open circuit power jack) (Radio Shack)
• 1 - 110V A.C. to 6V-7.5V D.C. power supply, rated 750 milli-amp current .
  (Caution - When using a multi-voltage power supply, make sure it is set to 6V!)

Electronic Parts:
Digikey ordering • 1-800-344-4539 • On line: www.digikey.com • List update 12/10/06
Waddle Warp Board - Series Production and Pilots - 22 Inch AMT ERTL “Cut-away” Upgrade

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LIGHT EMITTING DIODES (LED)

Navigation Running Lights
4  N1  White 3mm LED  67-1690  1.11
√  N2  White 3mm LED  "  "
1  N3  Green 3mm LED  67-1396  .15
13  N4  Red 3mm LED  67-1402  .148

ION Pod Strobe
√  S1  White 3mm LED  67-1690  1.11
√  S2  White 3mm LED  "  "

Warp Engines
√  0 Red 3mm LED 10x  67-1402
10  1 Orange 3mm LED 10x  67-1058  .155
10  2 Yellow 3mm LED 10x  67-1397  .15
2  Center Red 5mm LED Diff 2x  67-1110  .115
2.5ft Ribbon Cable, Multi-Color AE20M-25-ND

**ELECTRONICS CONSTRUCTION TIPS**

To prepare your Circuit Board and Warp FX discs drill out all the holes on the soldering pads.

To solder a component lead or I.C. pin to a pad on a printed circuit board, touch the tip of your iron to both the lead and pad at the same time. Lightly apply solder to the junction of iron and lead. A little solder will melt, releasing the rosin flux in its core. This flux will flow along the surface of metals, cleaning the way for solder. Apply just enough solder to lightly coat the lead and pad, but not so much that it forms a blob. An outline of the lead should still be visible beneath the solder.

Be sure that one of each lead goes to a negative and positive location as indicated on the component layout page 11. The Primary Hull lamps or LEDs should be soldered to the five lamp power pads on the board. Secondary Hull Lamps or LEDs are soldered to the jack plug in the lower hull.

Note: Solder wires to power jack and nacelle LEDs after running the wire ribbon cable through the Primary Hull dorsal connector slot, then the Ribbon Cable through the strut support slots on the secondary hull and then a hole through the right nacell part #27...
WADDELL WARP SYSTEM

ION POD / BEACON (STROBE)

WADDELL WARP SYSTEM

Schematic Diagram

PARTS LIST
D1: IN4001 DIODE
U1: 555 TIMER
U2: 556 DUAL TIMER
U3: 4017 CMOS COUNTER
C1: 47UF ELECT 16V
C2: 47UF ELECT CAP 16V
C3: 1 UF ELECT 50V
R1: 15K 1/4 WATT
R2: 3K
R3: 10K POTENTIOMETER
R4: 270 OHM
R5: 270 OHM
R6: 270 OHM
R7: 270 OHM
R8: 22K
R9: 50K POTENTIOMETER
R10: 18K 1/4 WATT
R11: 180 OHM
R12: 180 OHM
R13: 180 OHM
R14: 100 OHM
R15: 100 OHM
R16: 4.7K
R17: 33K
R18: 220 OHM
T1: 2N2222A POWER TRANS
T2: 2N2222A POWER TRANS
T3: 2N2222A POWER TRANS

INCADESCENT LAMPS (TYPICAL)

6 VOLT POWER SUPPLY

PARTS I.D.

LED
Light Emitting Diode

Diode

Transistor

Resistor

Capacitors

Potentiometer (Variable Resistor)
WARP ENGINES

WIRE RIBBON CABLE

CIRCUIT BOARD

WARP DISCS

(veiw from LED side)

CIRCUIT BOARD

(veiw from component side)

NAVIGATION RUNNING LIGHTS

INTERIOR LIGHTING PRIMARY HULL

ION POD STROBES
or
TOS Pilot Becons S1-S2
WHITE L.E.D. S

DON’S LIGHT & MAGIC

WADDELL WARP SYSTEM

Parts Placement

POWER SUPPLY
AC CONVERTER
6 VOLTS 700 to 800MA
**Nacelle Disc Construction:**

Pay close attention to the Parts Placement (Page 11). It is recommended to install the LEDs to the inner most ring of the Warp Disc first. Solder the positive of the LED, then loop the negative of the LED over to the center ring. Then solder in place. Then move onto the LEDs for the second ring and so forth.

Soldure in the larger T-1 red LED to the center pads of the Warp Discs by the proper polarity. Then soldure the positive jumper wire from the positive pad ring to the center LED pad.

Prepare the ribbon cable as follows:

Measure the length required to run throughout the model. Use the shipwide wire diagram as a guide. Split the cable as to the direction of the lighting feature. For example; the Warp Discs to Main Board.

Then split the wires further and strip away the plastic insulation. Twist the wires a bit and tin the ends with soldore.

Run the +5 volt ribbon wire through the drilled out disk hole on the outer ring on back of the copper side terminal and solder the wire into place.

Next solder the neg flashing wires 0-1-2 in sequence from the wire ribbon cable to the Warp Discs. Then the corresponding pads on the Main Board.

Next move onto installing the electronic components to the main circuit board using the parts placement guide on page 11.

Circuit Board Testing: (for a board test to be sure there are no loose wires or unsoldered I.C.s and nacelle “Warp” flashing pattern is correct)
Test the entire working electronics by installing power plug and jack, wire circuit board power leads to jack, then plug in power and test to see if everything works (running lights flash, nacelle lights rotate in proper sequence and direction, and the interior lamps all come on) before proceeding with construction. Turn the variable resistors adjust the Warp Discs and Navigation Lights to the proper flashing rate as you desire. If all systems work successfully, then you have completed the electronic components prior to installing into the model.

**Test notes:**
If assembly was successful and the board is fully operational continue on. White LEDs will work well in for the flashing Nav lights located on the bottom Starboard and Port and the Nav light on the main hull on top and forward. If the white LEDs need to be brighter use a lower resistor value like 100 to 160 ohms.

The Ion Strobe flasher unit should also work off of the 555 chip. On this model only one LED will be need to run off the circuit to the Secondary Hull aft transmitted to both sides by two fiber optic off of one white LED light source.
INSTALLING THE LIGHTING SYSTEM

Navigation Lights: Primary Hull.

Prepare the LEDs to fit into the drilled out holes on the Primary Hull top. This is a tricky area to pull off and remain faithful to the original studio miniature features. On the port and starboard sides the Nav Lights have a ring or socket like fitting to the lamp. Drill the hole out on the kit from the top and still have a ring of plastic remaining on the kit plastic. The T-1 3mm type LED may be too wide to fit and will have to be modified too fit the more narrow hole. With a slow speed power drill a small T-1 LED was fitted firmly into the chuck and turned down against a file at a point just above the lighting element. A wider countersink hole was carefully drilled from the inside bottom until the now narrower part of the LED protrudes from the ring mount. A green LED will flash on the Starboard (right side), red on the Port side (left), and a white LEDs at the B bottom Hull.

Note: In some Model Railroad lighting kits some T-1 LEDs have already been narrowed. Check with your hobby shop and Walthers Model Railroad Catalog.

Next step is to mount the lighting board to the bottom hull part of the model. After locating the board to the center of the main hull 4 small 1/2" square plastic riser blocks are notched and located to the hull interior and secured with super glue. Secure the circuit board to the top of the riser blocks. Make sure no light is blocked from the lamp located below the board for the lower sensor dome and lower deck ports.

Run the LEDs numbered N1 to N4 wires to the Nav lamps and secure to the bottom white LEDs to their holes and the ribbon wire cable to the interior surface. Also run the 6 volt GOW lamps to the open ports and window areas. Superglue the wires to the kits interior surfaces. Leave the topside Nav lights connected but with enough slack to run into the upper hull parts holes.

Note: Do not glue the hulls together yet (thus sealing in the lighting board). Final adjustments still must be made to the trim pots before enclosure and if a component goes after that out your screwed.

Test the lighting system often after each major assembly steps completion.
MAJOR COMPONENTS ASSEMBLY

To increase the structural integrity of the Engineering Hull where the power connection and base/stand interfaces with the model a strong piece of plastic is required to strengthen this area. I made mine by thermal forming a 1/8" thick plastic piece measuring 1" wide by 3" long plastic stock. The plastic was placed on a 2 1/4 dia. cylinder (a glass bottle) and heated to 300 degrees in an oven. Once the plastic has drooped around the cylinder it was removed from the oven and cooled. Another option is to use a 2 1/2 inch OD of plastic pipe like plumbing PVC plastic, cut a piece one inch long and then in half lengthwise. Drill a hole to fit the power connector jack. Super Glue or epoxy to the Starboard Secondary Hull interior side of part #13.

• Glue the Starboard Secondary Hull #13 connecting dorsal to the bottom of the primary hull.

• Mount the power connector jack plug through the bottom of the hull and reinforcing mount.

SHUTTLE BAY CLAM SHELL DOORS:

This is a very inaccurate feature of the Cutaway Enterprise model. The actual studio miniature had more subtle door panel lines and a flight Deck controlroom located on top.

• With the new resin copy of the Shuttle Bay door do these things if you wish to illuminate it: The control room window is drilled and filed in with clear resin for lighting. When set the new resin Shuttle Bay Doors piece is glued into place on the right side of the hull. Check fit of both hulls around the Shuttle Bay doors.

• Glue the Navigational Deflector Housing kit part #12 in place to the right side lower hull.

• Mount three or four lamps located front top of the connecting dorsal, center of engineering hull area and aft near the Shuttle bay area.

A single large white 5mm LED had two holes drill into the top of it and then two .030 fiber optics will run from it to the outside as the blinking Ion Pod (located aft). Mask the white LED and fiber optics to block light from the bulbs or the ambient light will shine through the Ion Pod flasher all the time. I painted it overall from LED to the Fiber Optics exit black.

Make a final check of lighting operations in the lower Engineering Hulls.

Glue the left side hull to the right side. Made sure the fiber optic run out to the left side hull. Glue with a liquid cement for the best type of bond.
**WARP ENGINE DETAILS**

There are a lot of kit errors on the Warp Engines. Here are the corrections working resin detail parts with the solutions done to them working from back to front.

**Aft End Caps:** Two resin replacement parts provided. Cut-away the kit molded Aft End caps on kit parts #8,7. Super glue or epoxy in place.

**Final Stage Flux Chillers:** Rectangular areas located just ahead of the End Cap on both Warp Nacelles inside and out. Only the kit part #8 is correct. The inside Chillers are missing altogether. Remove the Chiller from part #16 outer Port Side of the Warp Nacelle. This was wrong due to a kit manufactures short cut to pull it out from the injection molding process. Glue the new resin Flux Chillers into place with superglue or epoxy.

**Intake Sink Field Generators (6):** Three rectangular shapes located forward and on the bottom of the warp nacelle. All have the incorrect shape. Six new ones cast in resin is provided. Remove the kits generatores sand smooth and superglue the six new resin parts in place.

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**WARP FIELD GRILLS**

**Warp Field Enhancement Grids:**
To place these thin, small and delicate parts into place take utmost care in handling these parts. The first step in adding these pieces to the model is to remove from the kit the molded on relief of its grill detail. Make a small sanding pad from plastic sheet stock and a strip of Evergreen plastic as a grip to these dimensions:

- **Thickness:** 1/8 inch thick (.125) or 3mm
- **Length:** 1 3/4 inch or 45mm
- **Width:** 5/16 inch or 8mm

**Evergreen Strip Handle:** 1/8 x 1/8 square width, Length 1 1/2 inch (3mm x 3mm x 40mm)

Use doubled sided tape or spay glue adhesive to secure 150 or 250 grit sand paper (wet/dry) to the sanding pad. Sand the kit detail away and sand it smoother still with finer grades of sand paper to 600 grit.

Remove the resin sprue from the resin upgrade parts of the Grill Detail Aft. Attach it to the “U” shaped end of the kit indent trench of the Warp Engines Nacelles with a 5 minute epoxy. When set fill any gaps in with spot putty and sand smooth the angled join.

(Note: Epoxy glues give you more time for positioning into place. Super glues may be too fast to allow for error corrections before setting all too quickly.)
Then remove the grill resin backing from the grill parts and sand the bottom smooth with a larger sanding pad. Attach the longer grill piece first located up next to the Grill Detail Aft resin part. Use 5 minute epoxy again.

Glue into place the Horizontal details then the shorter forward grill.

**Painting:**

My observation from pictures seen at Web Sites that feature the Original Series studio model and the Greg Jien model for ST:DS9 of the USS Enterprise to be a darker gray in the indent trench of the Warp Engines Nacelles. A close match would be Medium Gray FS 35237. The Grills themselves silver. Antimatter Control Reactor loops, gun metal gray. Its forward housing; ships hull gray.

During painting of the model, first mask around the indent. Spray the silver onto the grills. Mask over when dry. Then spray on the finish color of Medium Gray. Let it dry. Then remove all the masking materials. Then install preappointed kit parts of the reactor loops and forward housing to the kit Warp Engines.
Planetary Sensor Array and Dome:
Located at the bottom of the Primary Hull. Kit detail was removed with a razor saw and new replacement Sensor Array resin ring piece and clear resin dome is put in place.

Warp Engine front Dome (Bussard Scope):
With the new clear resin piece test fit into place.

With these little detail parts finally installed, major component assembly can continue.

WARP NACELLE ASSEMBLY:
Make sure all wires are properly routed through the pylon supports and inside nacelle sides. You will have to remove some of the material from the inside of the lower pylon mounting tabs to allow the wires to pass through. Remove most of the material from the lower half of the mounting tabs, test fit often to prevent removing too much material. (This could be done prior to installing the wires) Super glue the Warp Engine LED disk to the inside ridge behind the dome opening. Then carefully glue the Warp nacelles and pylons together. Putty and file away seams. Make checks of the lighting system. If there are no problems apparent proceed.

Finally the Warp Engine Pylons are glued to the Engineering Hull. Start on the starboard side and make sure of proper alignment. After the adhesive cement set the Port side is glued in and lined up set in with a fast cure of gap filling super glue. This side proved to be a loose and sloppy fit. When everything was aligned properly the assembled set into a jig and allowed to dry overnight.

FINAL LIGHTING CHECKOUT
• LEDs are optional for the Impulse Engines to light up. You can request a clear red cast resin piece from DLM to do this option. Get some rectangular shaped LEDs for Radio Shack or Digi-key. Open up rectangular holes on the kits Primary Hull. Super Glue into place. A 250 ohm resister wired in series to each LED. The Impulse Engine part is installed over the LEDs.

• Lamps are positioned around the Primary Hull slightly elevated on a plastic strip.

• Two “constant on” position lights where located aft on the top of the Primary Hull. Drilled it out to fit .040 mill Fiber Optic runs up to one of the hull lights. The Fiber Optic strand was bent and oriented into the light of one of the lamps.

• Opaque the interior Navigation Running Light LEDs to restrict light from the Hull lamps to shine through. Taped over with patches of black electrical tape.
• Set the timings if the rotating and flashings LEDs through the trimming potentiometers on the circuit board. Warp lights set to show one flash at a time in sequence. Navigation Running light LEDs were also set to flash at a 2 second interval to approximately match the rate on the TV show. Check overall operation in darkness.

**PRIMARY HULL FINAL CLOSURE.**
Confidant with all lighting operations it is now time to complete principle construction. Make sure that all paint and glue was removed from the edges of the glue joint. The top of the Primary Hull was cemented with liquid cement and clamped together. Putty was troweled into the seam as the glue joint dries.

**MODEL FINISHING**
You now have entered into the next phase for this model of the Starship USS Enterprise; Painting and markings.

Considering this particular model has some rudimentary fit problems by the fact of the kits intention of being a ‘cut-a-way’ display model also meant to disassemble it for display. A lot of putty and smoothing at all seams must be done. Whenever I do models of these starships, a lot of sandable lacquer based primer is used, different grades of aluminum oxide wet sand paper and elbow grease is involved.

• All seams are inspected and filled. I like using red putty like Bondo or Testers Red
• Wet sand at this stage with 320 grit grade.
• Spot fill the seams and gaps with a sandable primer paint like Floquil and Krylon sandable gray primers
• Overall sand with 400 grit, rinse dust residue away between each change of grit.
• Overall sand with 600 grit.
• Overall sand with 1000 grit. Wipe it clean with a wet rag and let dry. But try to avoid getting water inside the model. The domes are left off to let model dry both inside and out.

**MASK OFF LIGHTED AREAS**
For the round ports a small disc of masking tape punched from a leather punch and placed on each round port. I used a Tandy leather punch 1/16 dia. with masking tape stuck onto a piece of scrap plastic sheet. The so called ‘blunts’ cut with this tool are perfectly round and applied to the port over the round .060 dia. fiber optic

Small rectangular pieces of masking tape was used for the rectangular windows. Also do the lighted panels on top of the Primary hull and the clear resin Upper Deck Levels and the Shuttle Bay Control window replacement piece.

A small dollup of Elmers white glue is applied to projecting LEDs. This will mask the LEDs. After painting just stab a sharp #11 blade and lift the white glue off.
OPAQUE LIGHTED AREAS AND SEAMS FOR LIGHT LEAKS

Airbrush spray paint the lighted ports and windows around and on all of the masked lighted areas and seams with Testers gloss black enamel. It is important to check your opaquing by testing after spraying in the darkness with the lighting system turned on. Spray only around the areas of the masked lighted areas and check inbetween coatings of the around seams of the of the model and near ports and windows to eliminate light leaks around the ship. Some spots may be un-accessable to the airbrush spray so get black paint into those areas with a small pointed brush to fill that light gap or seam leak.

Notes on My Painting Tips:

I used mineral spirit based enamel paints for painting from now on at this point. My paint preference with Testers Model Master enamel paints gives me a smooth coverage. It adheres very well to plastic, better so than most water bases acrylics, but mineral spirit thined enamels takes a while to dry and cure before handling. Be very careful when handling the model and allow “days” of drying time as you do this inbetween coatings. I use fans to help in drying but always check that paint is dry and cured before handling the model. The rule of thumb is that the coating is smooth, cool and not tacky to the touch go ahead and handle it. And be sure your hands are clean, dry and free from natural skin oils as well before proceeding. Wash your hands often

PAINTING

In general all of the starships details that I paint start at the small areas first. These ares are left to dry overnight then masked off and proceed with the larger area painting around it. This saves a lot of time and masking materials when painting small details onto the model.

Overall primer coating: Krylon or Duplicolor Sandable Primer:  Gray color sprayed as base coat. Identifying flaws are easier to spot. Sand smooth and spot paint again in Primer Gray.

Black, Semi-gloss: Rings at front of Warp Nacelles.

Steel and Graphite:  A natural metallic panel on the bottom front of the Warp Nacelles. Sprayed overall in Steel and shaded panes with graphite.

Gun Metal Blue and Graphite:  Vents at rear of Warp Nacelles. Nacelles End caps

Dark Ghost Gray:  Detail above the Dorsal Connector and the Impulse Engines. Indent trench of Warp Nacelle

Gloss White:  Sensor Domes a light coating to let light through the top and bottom sensor domes, balls at Nacelle End Caps.

Flat Black: Front of the Engineering Hull behind the Deflector Dish from the first ring inward.

Copper: Deflector Dish

Light Ghost Gray: Used for an overall hull finish color. A very close match to the legendary "Chevy Truck Primer Gray".

Allow all painting steps to dry and cure before proceeding.
Some Thoughts on Painting the USS Enterprise

The first selection of good photos of the latest restoration of the Studio model at the NASM taken by fellow modeler Lonnie Misner just after this model was released from AMT. The copies of the color prints were very sharp. It showed a lot of color variations and shades from the latest restoration. Many of the details are striking and some what stark. If the authorities I have earlier sighted are correct in their word for a desired restoration resulting in finish and detail of the third season of the television series Star Trek. One could say they overdid it.

In that third and last TV season of Star Trek the USS Enterprise was given a good going over with paint detail and weathering effects. Even panel lines where drawn on with no less than a pencil. It also had a light olive tint indicating the panel lines. But be mindful of this. There was just not that much footage shot of the miniature in the third season. Much stock footage was still used from the First Season and the Pilot Episodes. Any new shots with the new footage were not that noticeable when it is lit in a studio, shot through camera filters, onto 60’s era film stock and run through image processing to put moving star fields in the background. All this being done with imaging technology of the 1960’s. Color television at that time was at most primitive an infant's very beginnings. Most households did not even have color television. So as you see the Enterprise on your TV you’d still think the ship was white, light blue or green whatever. So if it seems that the this model looked different than what you saw. So the color debate continues as to exact color used back then. But to me Light Ghost Gray is close enough.

Now Back To the Work Bench!

After a 72 hour cure to the primer gray coat another wet sanding was done overall with 1000 wet paper then wiped clean again. A finish coat of Testers Model Master FS 36375 Light Ghost Gray was sprayed on. This is the base color of the hull.

Painting Materials note:
Masking Tape. 2 inch and 1/4 inch. Friscut paper, and Post-it Notes (tm), Micro-Scale Liquid Mask.

Painting References note: Photos from Vlassenko-Misner-Cullen/NASM photo collections.
Ballantine USS Enterprise Plans, by Franz Joseph

My shading colors are now right off the old style Testers little square bottle of paint, Air Craft Gray FS16473. This the next darker shade of Testers slightly off from the model masters variety. After a test spray on a test panel of Lt Ghost Gray, the color break reveals a matte sheen and surprisingly a bit of an olive green tint to the color. This was found to be ideal without having to mix that color into the Aircraft Gray. Using all the photos and plans at hand, panel painting effects begins.

I started on Warp Nacelles with vertical panel rings. Panel rings were sprayed on the leading edge of the panel. The stick side of a Post-It note was used as a mask. Frehand airbrushed streaks with the sharp straight edge of a post it note are added horizontally.

Secondary Hull: same effect and results.

Bottom off Primary Hull: 28 radial panel lines at 13 degrees run up to the top of the hull. Leading edged of shade color painted on each. Friscut paper cut with a #11 knife blade mounted on a bow compass was used to cut the concentric panel rings.

Top of Primary hull; same procedure.

Last color coat: A thinned mixture of FS 36375 Lt. Ghost Gray was sprayed lightly overall the ship to tone down the panel line edges and contrast with more highlight streaks horizontally. My airbrush was a Badger XF100 with a fine spray tip and needle was used. This technique yielded a subtle paneled, weathered spaceship and satisfactory results.
Decals, Details and Markings:

Surface preparation for decaling is a clear coat of Micro Scale Gloss over the marking areas.

I then started applying decals, cut close as possible to the color edge, and used Micro Sol as a setting solution. I worked from the bottom to top of the model. Any kind of silvering and bubbles were dealt with by poking holes and using Solveset later on. Solveset is a more aggressive decal setting solution. Micro Mark decal film printed with a ALPS proved to be a worthy way to get rather than using the kit supplied decals for the markings. It has proved to be very durable and not prone to cracking and is compatible with all the different decal setting solutions I have used.

After the decals have set up I next removed all of the small lighted ports and windows. The areas around the windows were lightly wet sanded (600 or 1000 grit) to remove the high points around the painted edges of ports and windows.

A final protective coat was sprayed overall the hull / nacelle surfaces with Micro Scale clear satin.

Removed all the remaining masking materials from the painted model.

Detail painted the following parts:

Deflector Dish (Copper and Silver)

Sensor Domes (gloss white with a blue tint). (clear pieces of the upper and lower sensor domes)

Warp Engine clear Domes were painted on the inside. First, Tamiya Acrylic clear red in streaks then an over all coating in clear orange. A thin coating of gloss white was sprayed inside to diffuse the LED lights. The outside is left clear unpainted and polished. Glue into place.

Installed the remaining pre-painted fittings. On the red-orange Warp Nacelle caps small plastic detail parts were added as a dome ‘retainer’ as shown on my NASM photos. The white painted sensor domes were glued in place also as well as the main deflector dish.

Display Mounting and Power Supply

As with all of my lighted Star Trek models I like to mount them on a stand that will provide power to the ship. I like to use unfinished wooden jewelry boxes and pre-miter cut wooden plaques. I find these at craft stores. I stain the based with a black wood stain and clear coat the wood with clear polyurethane. A brass tube selected by size, what ever fits a jack plug is the support stand. A center wire runs to the tip as the positive current. The brass tube itself is the negative and completes the circuit. A switch is wired into the system. The 6 volt 700ma power supply is connected into the box. As an added effect I added a sound board. I purchased a PlayMate toy of the USS Enterprise that had a sound effects board. I gutted out the electronics from the toy and wired it into my stand assembly. Small push buttons and a speaker was mounted. The sound effects used is Warp Drive, Photon Torpedo and Phasers.

I am very happy about the way the model turned out. There were many problems to fix on the cutaway kit. The AMT model is not that bad if certain production shortcuts where not used. But in the end I have finally constructed a miniature that is very authentic and faithful to the 11ft studio model as seen in the last season of the Star Trek series.
Pictured below is the original studio model today at the Smithsonian Air & Space Museum. The resin cast pieces that I have provided and the lighting effects will most certainly help you on your way without the hassles of scratchbuilding and electronic circuit design.