

M-Sorter Principles of Operation

The workings of the M-Sorter can be illustrated by operating it manually. With the rotor at its halfway point, fill the feeder tube with M&Ms. (Note: A small number of M&Ms may be too large and get stuck in the tube. These should be eliminated.) Rotate the rotor fully clockwise. One M&M should fall into place on the baseplate. You can then turn the rotor counter-clockwise, pushing the M&M under the fuzz pad, which wipes and steadies it, then into position under the color sensor. The detent in the separator plate helps to center the candy under the sensor, and you can back off the rotor a little to allow the candy to settle. Note that by rocking the rotor back and forth, you can reposition the candy under the sensor and even rotate it. Now, turn the rotor counterclockwise some more, pushing the candy ahead of it. As it enters and passes through the vial zone, the candy will rock up and over the ridges of the separator plate. By simply reversing the rotor's direction when the candy is positioned near a certain target hole, the candy will be swept down the hole and into the vial below.

There are eight possible drops at fifteen-degree angular intervals. With the feed tube at position "0 degrees", the inspection station will be at 30 degrees, the first drop at 75 degrees, the next at 90 degrees, and so forth, with the last drop at 180 degrees.

To assist in calibrating the servo to align with the various rotor stations, two small holes have been drilled in the rotor. These will align with the sensor when the rotor is at positions 60 and

180 degrees. When the color sensor "sees" these holes, it reports a lower light level (darker color). That way a given servo pulse width can be pinned to each of these two known positions and the other pulse width/position pairs interpolated from them.

The rotor, although not white, can still be used as a target to white balance (calibrate) the color sensor. Anywhere between the two holes can be used as a target.

If the rotor tries to position an M&M under the sensor, but there's no candy there, the sensor will see the black baseplate. This can be used as an indication that the feed tube is empty or that some other operator intervention is required.

Some additional things to consider when programming this sorter:

1. At full servo speed, the rotor will move too fast to keep the candy under control. You will need to use controlled motion to achieve the best results.
2. You will need to establish some way to calibrate the unit for each color to be sorted. The calibration data can be saved in the BASIC Stamp's EEPROM. A white balance should be done each time the machine is reset, however.
3. You will also need to figure out a matching algorithm for the various colors. That is, given an unknown color, which of the known colors is it closest to, and is it close enough?

Try to program this sorter on your own first. It's a challenge, to be sure, but the results can be very rewarding. If you get stuck, check the Parallax website (www.parallax.com) for help.

M-Sorter Kit Sorts M&Ms[®] by Color!

PARALLAX 
www.parallax.com

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ASSEMBLY MANUAL

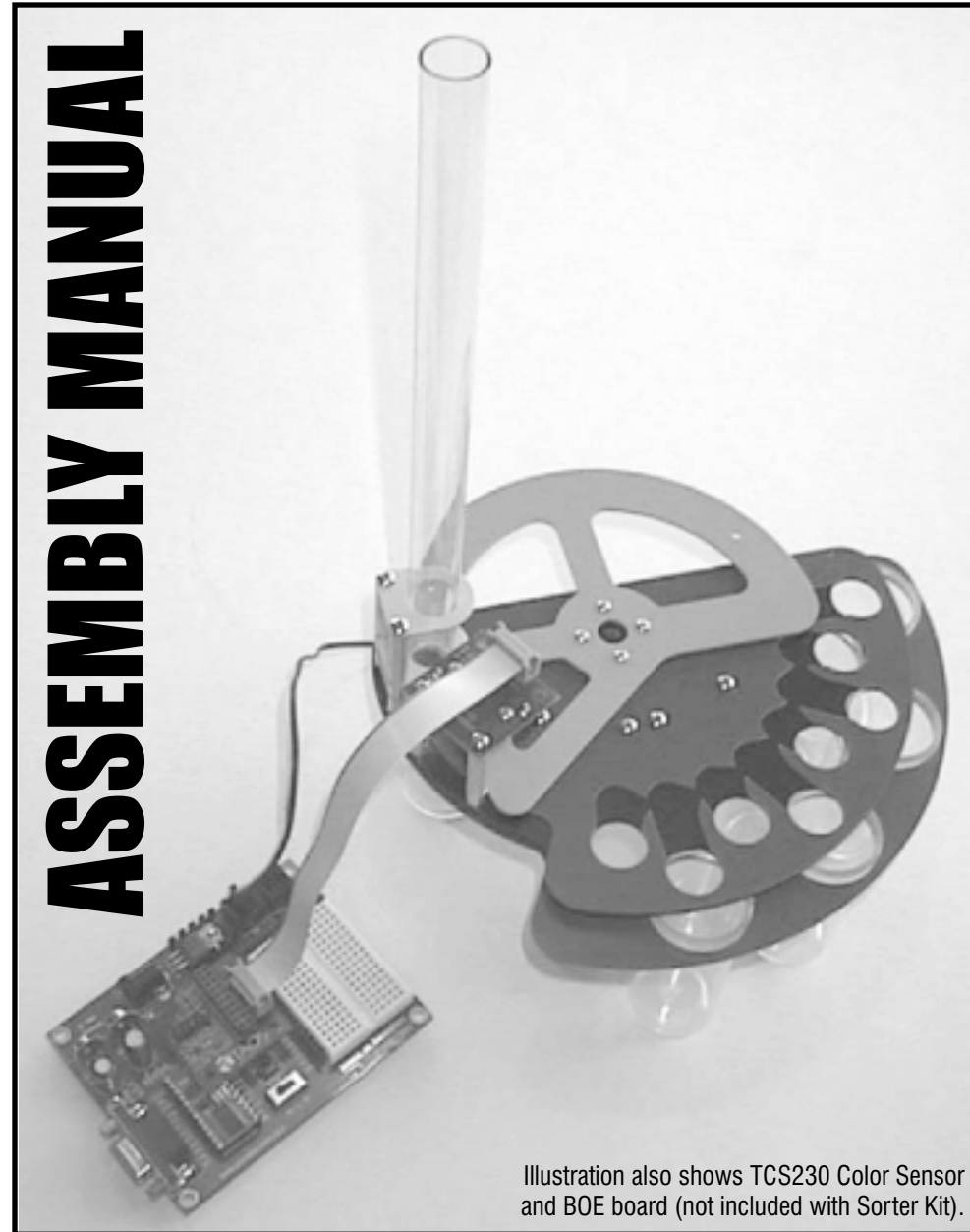


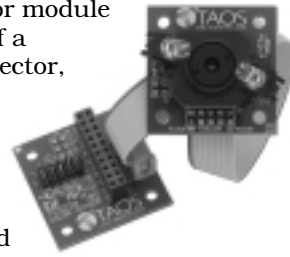
Illustration also shows TCS230 Color Sensor and BOE board (not included with Sorter Kit).

PARALLAX

Products for Sensing Light and Color

TCS230 Color Sensor Evaluation Kit

The TCS230 sensor module set is comprised of a complete color detector, including a TAOS TCS230 RGB sensor chip, white LEDs, collimator lens, AppMod adapter board, and connecting cable. It interfaces easily to any BASIC Stamp module, either through an AppMod socket or connected directly, and can detect and measure a nearly limitless range of visible colors. **This is the sensor used with the M-Sorter Kit. It is sold separately.**



QTI Sensor

The QTI Sensors were originally meant to sense the outer rim of a Sumo-Bot ring; however these little line sensors can serve other purposes.

TSL230 Light to Frequency Converter

The Texas Advanced Optoelectronic Solutions (TAOS) TSL230 sensor precisely measures light using an array of photodiodes, with an output of digital square waves. The TSL230 has an input dynamic range of 160dB; that is, it can measure light over a range of 100,000,000-to-1.



Find these and other sensors by clicking on the "Accessories" portal at:

www.parallax.com

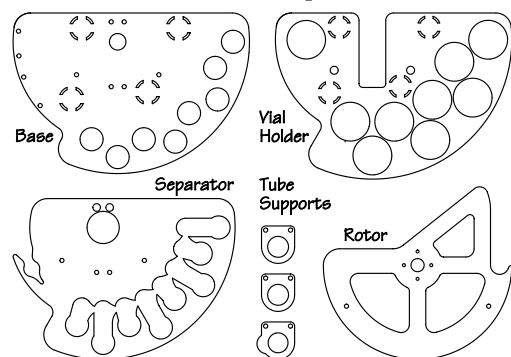
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Parts List

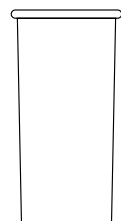
1 set Black, Blue, and Tan Composite Pieces:



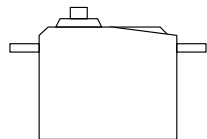
1 ea. Clear Plastic Feeder Tube:



9 ea. Clear Plastic Vials:



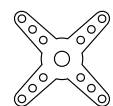
1 ea. Servo:



1 ea. Servo Screw:



1 ea. Servo Control Horn:



4 ea. Velcro® Hook Dots:



4½ ea. Velcro® Loop Dots:



4 ea. #2 x 3/16" Pan Head Sheet Metal Screws



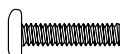
4 ea. #4-40 x 1/4" Flat Head Machine Screws



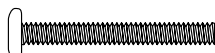
10 ea. #4-40 x 1/4" Pan Head Machine Screws



2 ea. #4-40 x 1/2" Pan Head Machine Screws



2 ea. #4-40 x 1" Pan Head Machine Screws



2 ea. #4-40 Hex Nuts



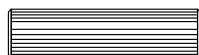
6 ea. #4 x 1/4" Thru-hole Spacers



6 ea. #4-40 x 3/8" Threaded Standoffs



4 ea. #4-40 x 1" Threaded Standoffs



M-Sorter Assembly

With this M-Sorter Kit, a Parallax BOE board populated with a BASIC Stamp 2, a Parallax/TAOS TSC230 Color Sensor, and some programming ingenuity, you will be able to build a machine capable of sorting M&Ms® into eight different color categories. To assemble the parts included with this kit, all you will need is a small Phillips screwdriver.

•Begin by stacking the black baseplate and blue separator plate as shown below:



•Fasten the two plates together with ¼" pan head screws and the 3/8" threaded standoffs. (Two of the screwheads will go clear through the blue plate.) •Make sure the two plates align, then tighten the screws. The bottom side will look like the photo below. •Attach the four Velcro hook (non-fuzzy) dots as shown to the locations marked on the black baseplate.



•Adhere the Velcro loop (fuzzy) half-dot to the bottom feed tube support (the one with the bump) as shown:



•Adhere the remaining four loop dots to

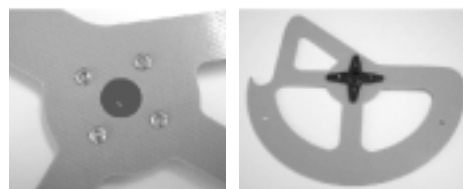
the vial holder plate in the locations indicated:



•Pull the round wheel off the servo after removing its screw. •Secure the servo to the four 3/8" standoffs using the four flat head screws, as shown below:



•Using the four #2 sheet metal screws, attach the servo control horn to the rotor plate, as illustrated. (The splined hub does *not* protrude through the hole. It points down in the left photo; up, in the right one.)



•Press the rotor assembly onto the servo shaft, and rotate it as far counterclockwise as it will go. •Remove the rotor assembly and, with the shaft still rotated counterclockwise, position the rotor as shown in the photo on the next page, or just slightly clockwise from that. The M&M carrier hook should cover at least part of the far right slot. •Press the rotor assembly back onto the shaft and secure using the shaft screw that came with the servo.



•Rotate the rotor fully clockwise. •Secure the two 1" screws to the black baseplate, as shown below, using the two hex nuts.



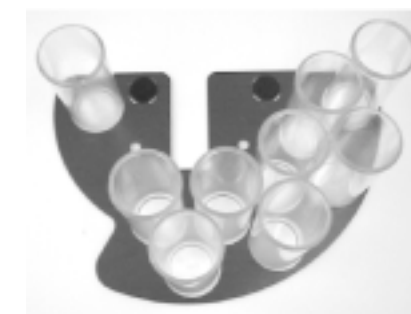
•Over each screw slide one ¼" round spacer, the bottom feed tube support (Velcro side down), another ¼" round spacer, and one of the other feed tube supports. •Secure this whole stack with two of the 1" threaded standoffs. •Attach the remaining tube support atop the 1" standoffs with ¼" pan head screws. See photos:



•Attach the remaining 1" threaded standoffs to the black baseplate using the ½" pan head screws and the ¼" standoffs. Note the order of attachment (from the bottom): ½" screw, baseplate, ¼" spacer, 1" standoff. They should look as shown:



•Place the vial holder on a flat surface, Velcro side up, and stand the nine vials (caps removed) in their respective holes, as shown:



•Lift the vial support plate until the vials hang from their rims. •Fit the vial support plate over the 3/8" standoffs (alignment pins) on the bottom of the black baseplate through the holes provided. •Press the Velcro hook and loop dots together to hold the vial support plate up. •Stand the whole assembly on a flat surface. •Slide the clear plastic feeder tube into its mount. This completes the assembly of the M-Sorter's mechanical portion. The two remaining ¼" screws are for attaching the TSC230 color sensor to its support posts, as shown on the front cover.