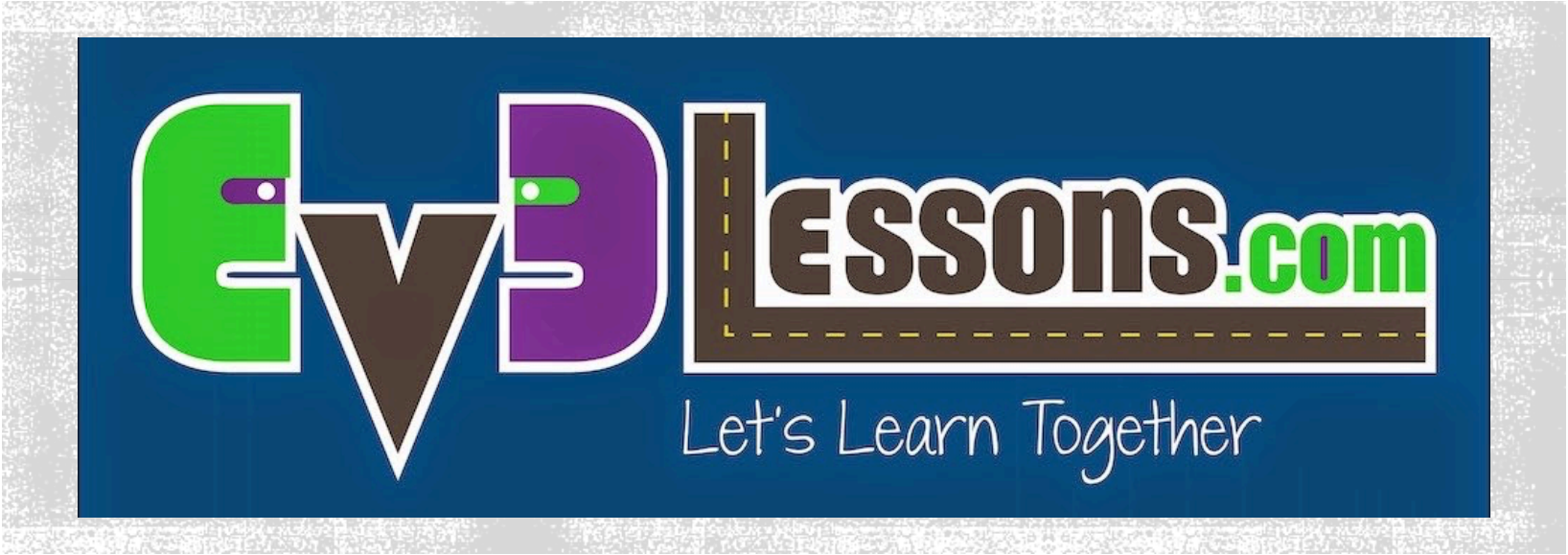


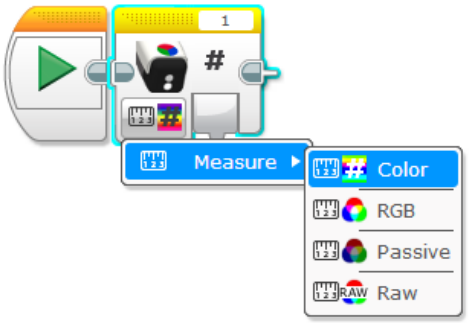
INTRODUCTION TO HITECHNIC COLOR SENSOR

By Sanjay and Arvind Seshan

LESSON OBJECTIVES

- Learn how to use the HiTechnic Color Sensor V.2
- Learn how to configure your sensor
- Learn how to position your sensor
- Learn about the different modes the sensor uses

DOWNLOADING THE BLOCK



- The EV3 Block for the sensor can be download from the manufacturer's download page:
  - https://www.hitechnic.com/downloads
- Add the block to your software.
  - If you do not know how to add a block to your software, complete the "Importing HiTechnic Blocks" lesson on EV3Lessons.com → Lessons → WRO

HiTechnic EV3 Color Sensor Block

This is preliminary release of the HiTechnic EV3 Color Sensor Block. Note that this block only supports the EV3 and will not work with the NXT. Zip file includes both the Color Sensor block and a sample program that shows the color sensor values on the EV3 screen. See instructions at top of this downloads page for installation instructions.

	Description	Version	Release Date	Size	
	HiTechnic EV3 Color Sensor Block	0.3	February 18th, 2014	41.85 KB	Download Now

CONFIGURE FOR ELECTRICITY FREQUENCY – PART 1

- There are two electric supply frequencies commonly used (50Hz and 60Hz).
- The sensor is configured for 60Hz (US, Canada and other countries) by default
- To check if you need to configure your sensor, consult the Electricity Frequency Table on this page: https://www.hitechnic.com/colorsensor
- If you need to switch the frequency, you must have an NXT and NXT software installed

Electric Frequency Table

COUNTRY	FREQUENCY
Afghanistan	50 Hz
Albania	50 Hz
Algeria	50 Hz
American Samoa	60 Hz
Andorra	50 Hz
Angola	50 Hz
Anguilla	60 Hz
Antigua	60 Hz
Argentina	50 Hz
Armenia	50 Hz
Aruba	60 Hz
Australia	50 Hz
Austria	50 Hz
Azerbaijan	50 Hz
Azores	50 Hz
Bahamas	60 Hz
Bahrain	50 Hz
Balearic Islands	50 Hz
Bangladesh	50 Hz
Barbados	50 Hz
Belarus	50 Hz
Belgium	50 Hz
Belize	60 Hz
Benin	50 Hz
Bermuda	60 Hz
Bhutan	50 Hz
Bolivia	50 Hz
Bosnia	50 Hz
Botswana	50 Hz
Brazil	60 Hz

CONFIGURE FOR ELECTRICITY FREQUENCY - PART 2

- Download the Configuration Program for 50Hz (SetTo50Hz) from https://www.hitechnic.com/colorsensor
- Start NXT Software
- Connect an NXT Brick to your computer
- In the NXT software
  - Create a New Program
  - Select the NXT Window button
  - Pick the Memory Tab
  - Pick Download and select the file to the download to the brick
- Connect the HiTechnic Sensor to Port 1
- Use the brick buttons to pick My Files → Software Files → SetTo50Hz file. Select the file to run the program. You should see the confirmation screen on the right
- Disconnect your HiTechnic Color Sensor and use it on your EV3

Memory Tab

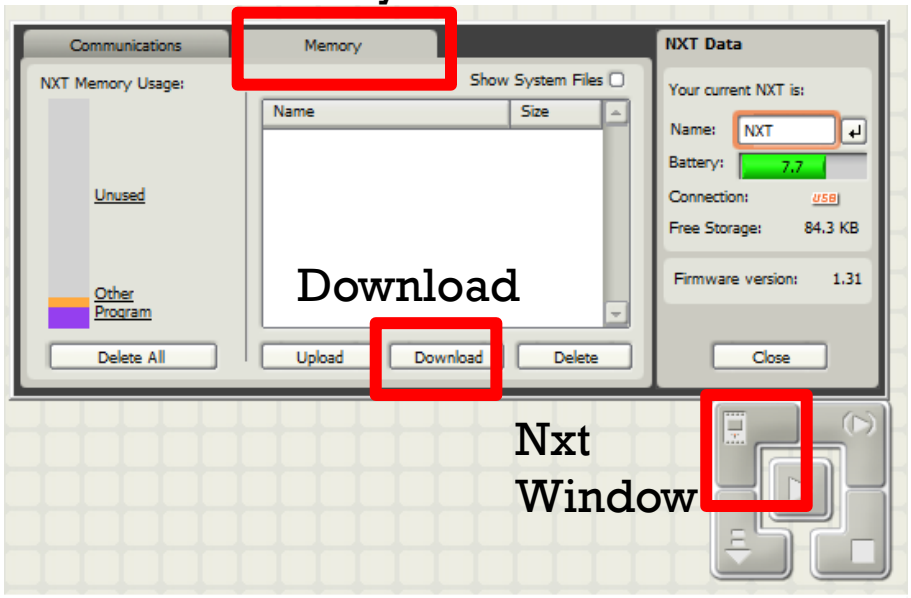
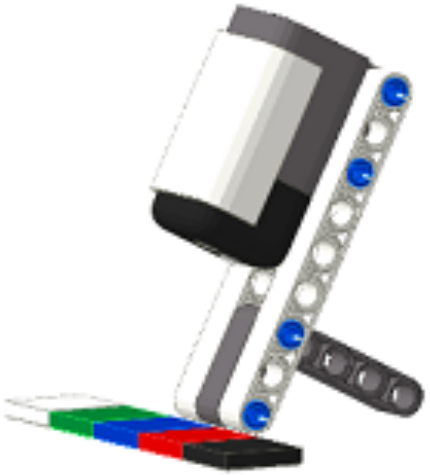


Image Credit: HiTechnic.com

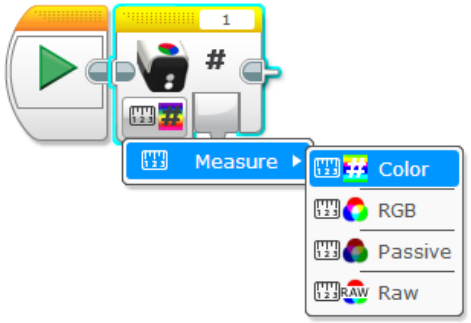
Note: We confirmed these instructions. We also compared sensors set to 50Hz and 60Hz. We found that the frequency does make a difference in the readings depending upon room lighting.

POSITION & ANGLE (FROM HITECHNIC)

- The Color Sensor V2 works best when it is positioned a little further away from the target
  - Approximately 4 LEGO studs distance (see image)
- Ideally, the sensor must be placed at an angle. The angle prevents the direct reflection of the light from the LED from coming back into the sensor element (see image)

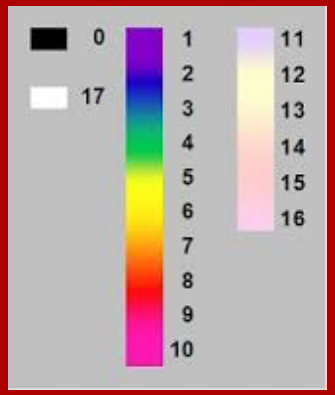


FOUR MODES



Color Mode

- Can recognize 18 colors



RGB Mode

- Outputs red, green, blue, and white values ranging from 0 to 255

Passive Mode

- Outputs red, green, blue, and white values that do not range from 0 to 255
- Includes external light readings
- Can be use to measure room and outdoor lighting

Raw Mode

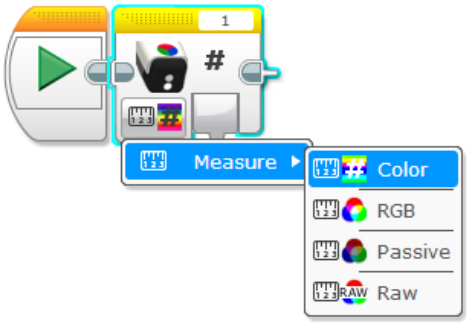
- Outputs red, green, blue, and white values that do not range from 0 to 255
- This mode provides the raw data that the sensor reads before being processed.

RGB VS PASSIVE MODES

- Comparing sensor readings in Passive Mode in two different lighting conditions reveals that in Passive Mode, the reading is impacted by ambient light
- In RGB mode, the sensor measures and subtracts ambient light

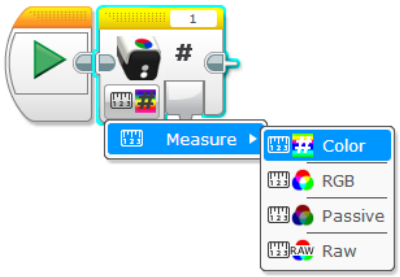
	RGB Mode Dim Lighting			RGB Mode Bright Lighting			Passive Mode Dim Lighting			Passive Mode Bright		
LEGO Color	**Red**	**Green**	**Blue**	**Red**	**Green**	**Blue**	**Red**	**Green**	**Blue**	**Red**	**Green**	**Blue**
White	123	123	102	121	122	101	72	61	39	785	1062	475
Red	64	17	8	63	16	7	47	20	10	1034	543	185
Yellow	110	80	13	114	83	13	58	40	14	1851	2122	392
Green	14	32	19	10	28	17	11	19	11	183	575	226
Blue	10	23	53	10	23	54	12	18	19	106	262	240
Black	9	9	9	8	8	8	13	12	8	87	135	65
Brown	21	12	9	20	12	8	21	16	9	324	309	137

MORE ABOUT RGB MODE



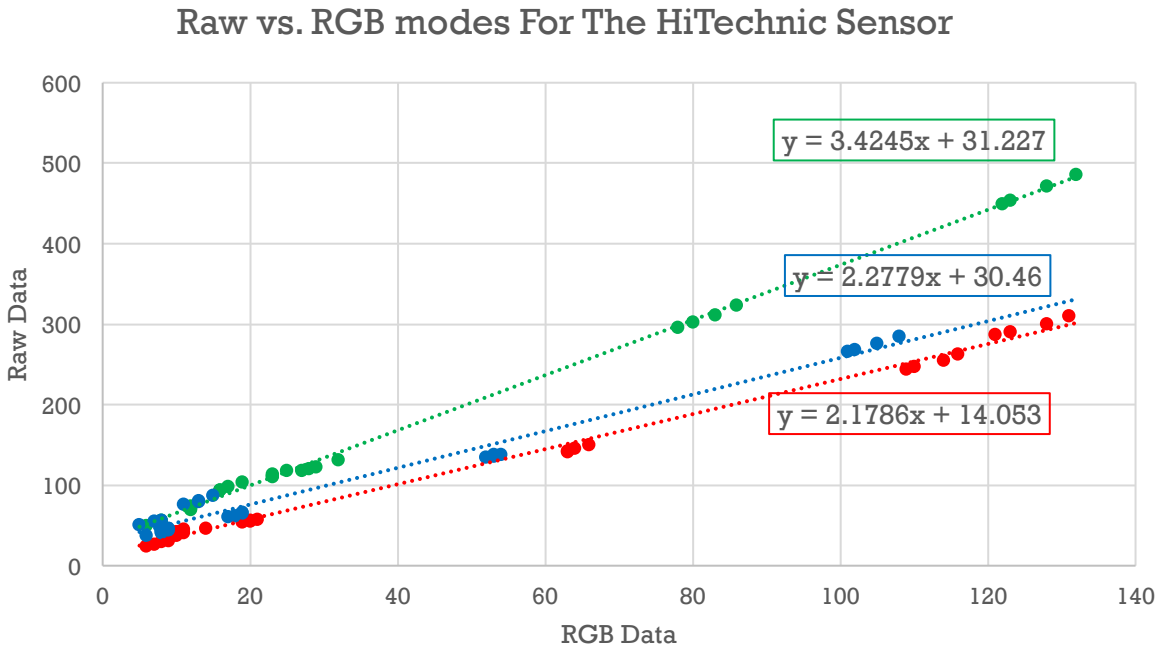
- In RGB mode, the sensor measures and subtracts ambient light
- However, there are limits to this "subtraction". In very bright light, the sensor is overloaded (see passive values) and cannot subtract effectively. Resulting in unpredictable RGB mode readings

	RGB Mode Dim Lighting			RGB Mode Bright Sun Light			Passive Mode Dim Lighting			Passive Mode Sun Light		
LEGO Color	**Red**	**Green**	**Blue**	**Red**	**Green**	**Blue**	**Red**	**Green**	**Blue**	**Red**	**Green**	**Blue**
White	123	123	102	0	0	126	72	61	39	37810	39305	32973
Red	64	17	8	0	17	11	47	20	10	37692	25968	16953
Yellow	110	80	13	0	0	33	58	40	14	37689	39317	25230
Green	14	32	19	8	30	15	11	19	11	20046	31605	21915
Blue	10	23	53	12	23	51	12	18	19	21447	30028	28308
Black	9	9	9	3	6	7	13	12	8	16012	18125	13029
Brown	21	12	9	18	12	9	21	16	9	25995	23004	15443



RAW VS. RGB MODES

- By conducting tests, we found that the Raw Mode readings are processed through a linear equation to generate the RGB data.
- Note that the different colors are scaled differently. White might show up as [120 red, 120 green, 120 blue] in RGB mode but as [285 red, 450 green, 300 blue] in Raw Mode



LESSONS LEARNED

- **Position:** Follow manufacturer's recommendations for angle and distance from target.
- **Configuring**: If you live in an area that is 50Hz, you will have to configure your sensor using an NXT.
- **Color Mode:** This mode can measure 18 colors.
- **Passive Mode:** Does not subtract values for external light. This mode is useful to measure external lighting.
- **Raw vs. RGB:** The data outputted from the RGB mode is derived from the Raw mode's readings. The raw data is processed for the RGB mode.

CREDITS

- This tutorial was created by Sanjay Seshan and Arvind Seshan
- More lessons at www.ev3lessons.com