		Bill of Materials for CubeSatSin	n v1	2 for i	nfo see l	http://out	ocataim ara					
		bill of Waterials for Cubesatsiii		.2 101 11	1110 300 1	nup.//cul	iesatsiiii.org					
		Note: if you have the v1.0 PCBs, here is						sheets/d/1UQdsXe-uZ38PD			-	
		Note: if you have the v1.1 PCBs, here is	the B	OM:	https://do	cs.google	.com/spread	sheets/d/1y94Ut4WInfJ7ZC	4sU9S5768G5_BMU9aPUG	inHsb_djTI/edit?usp=sha	ring	
		15						and a file that the control of the				
		If you have a Google account, you can me The colored rows which begin with "Alt"							у			
		The colored rows which begin with Air	muic	ute uiteri	nutives. On	LIIELK LIIE	a choice to g	jet trie b crioice				
		Main Board		https://c	ithub.com	/alanbjohr	nston/CubeS	atSim/blob/master/hardwai	e/v1.1/cubesatsim-main-1	.2_schematic.pdf		
= 1	Ref	Item		Qty		Total	Source	Source URL	Alternate Source URL	Notes	Additional Source URL	
= +	U10	5V boost regulator 500 mA		1	\$4.00	\$4.00	eBay	https://www.ebay.com/sch/i			https://es.aliexpi	
3	U9	NiMH CN3085 3s charger 1x14 male breakaway header		1	\$2.99 \$0.47	\$2.99 \$0.47	eBay Digikey	https://www.amazon.com/V			tead of China for fast delivery st and NiMH charger and J4	
5		USB-C charger with Micro USB adapter		1	\$10.99	\$10.99	Amazon	https://www.digikey.com/en https://www.amazon.com/		Used for charging batter		
= +	X1	SC1464-ND 3.50mm Headphone Phone Jack		1	\$2.10	\$2.10	Digikey	https://www.digikey.com/p			/z/35RAPC4BH3-3-5mm-Threader	d-Right-Angle
= +	D1-D7	Diode 1N5817RLG D1, D2, D3, D4, D5, D6, D	7	7	\$0.40	\$2.80	Mouser	https://www.mouser.com/			n/stmicroelectronics/1n5817/recti	
][Remove Before Flight Tag		1	\$8.00	\$8.00	Amazon	https://www.amazon.com/	https://www.amsat.org/pro			
= +	X1	1/8" 3.5mm Plug Audio Jack Connector		1	\$1.22	\$1.22	Digikey	https://www.digikey.com/pro			thingiverse.com/thing:1141906	
믺		Alt 1a: Pi Zero WH	\mathbf{L}	1	\$14.00	\$14.00	Adafruit	https://www.amazon.com/V			and Pi Zero 2 W, if without headers	s Pi Zero W, a
3		Alt 1b: Pi Zero W Alt 1b: 2x20 male breakaway GPIO header	L	1	\$10.00	\$0.00	Adafruit Adafruit	https://www.amazon.com/R		Also works with Pi Zero If it doesn't come with you	r Di Zoro W	
5		16GB micro SD Card with cubesatsim image		1	\$0.95 \$20.00	\$0.00	Amazon	https://www.adafruit.com/pr https://www.amsat.org/prod			can be used with free download of	cubecateim i
= +	J1	GPIO 20x2 female stacking header extra tall		1	\$2.95	\$2.95	Adafruit	https://www.adafruit.com/pr		This one is different from		-30004131111
_ +	U1-U8	B Blue INA219 High Side DC Current Sensor Br		8	\$1.65	\$13.20	Aliexpress	https://www.amazon.com/A			o find and have fewer defectives.	You only need
5		6 position right angle female header		8	\$0.66	\$5.28	Digikey	https://www.digikey.com/en		sockets for INA219 boar		,
וֹכ		6 position right angle male header		8	\$0.77	\$6.16	Digikey	https://www.digikey.com/en		mouting headers to mou	int INA219s in sockets	
-,	S1	Pushbutton switch, DPDT, CFP2-2RC4-AW		1	\$3.64	\$3.64	Digikey	https://www.digikey.com/pro	https://www.mouser.com/			
- :	R11	1k Ohm resistor, 1/8 Watt, 20% tolerance		1	\$0.10	\$0.10	Digikey	https://www.digikey.com/en				
= +	R12	100 Ohm resistor, 1/8 Watt, 20% tolerance		1	\$0.10	\$0.10	Digikey	https://www.digikey.com/en				
=+	R13 R3,R4	220 Ohm resistor, 1/8 Watt, 20% tolerance 4.7k Ohm resistors, 1/8 Watt, 20% tolerance		2	\$0.10 \$0.10	\$0.10 \$0.20	Digikey	https://www.digikey.com/pro				
= +	LED1	Green LED 5mm clear lens	_	1	\$0.10	\$0.20	Digikey	https://www.digikey.com/en https://www.digikey.com/pro				
= 1	LED2	Blue LED 5mm clear lens		1	\$0.21	\$0.21	Digikey	https://www.digikey.com/pro				
٦į	LED3	Red LED 5mm clear lens		1	\$0.15	\$0.15	Digikey	https://www.digikey.com/pro				
-,	D8	5.1V 400mW Zener		1	\$0.26	\$0.26	Digikey	https://www.digikey.com/e				
= 1	F1	PTC resettable fuse, 1.2A		1	\$0.34	\$0.34	Digikey	https://www.digikey.com/p				
3	X2	Alt 2a: SMA vertical female connector Alt 2a: SMA 6" male to female for antenna c	\mathbf{L}	1	\$2.52 \$7.99	\$2.52 \$7.99	Digikey	https://www.digikey.com/en	https://www.digikey.com/e		nector or the tape measure for the	antenna
51		Alt 2a: SMA 433 MHz antenna	1	1	5.07	\$5.07	Digikey	https://www.amazon.com/g https://www.digikey.com/en	https://www.newark.com	Don't need if using tape m	easure antenna	
51		Alt 2b:Tape Measure for antenna		1	\$9.09	\$0.00	Amazon	https://www.amazon.com/S	https://www.amazon.com/	The antenna is either a	tape measure, or a SMA antenna	
5		Alt 2b: 2.5mm screw for tape measure anter	1	2	\$0.38	\$0.00	Digikey	https://www.digikey.com/pro				
][Alt 3a: Main PCB with LPF installed	\leq	1	\$10.00	\$10.00	AMSAT	https://www.amsat.org/pr		Gerbers are available on G	itHub to make your own PCBs https://	github.com/ala
⊒		Alt 3b: Main PCB without LPF				\$0.00						
=+	L1 C1	Alt 3b: LPF SMD 13nH 0603 Alt 3b: LPF SMD 18pF 0603	1	1	\$0.17	\$0.00	Digikey	https://www.digikey.com/pro				
= +	C2	Alt 3b: LPF SMD 16pF 0603	1	2	\$0.22	\$0.00	Digikey	https://www.digikey.com/en https://www.digikey.com/en				
= +	R1	Alt 3b: 1k Ohm resistor		1	\$0.10	\$0.00	Digikey	https://www.digikey.com/en				
٦į	J3	USB-C breakout		1	\$4.95	\$0.00	Sparkfun	https://www.sparkfun.com/p				
						4						
				TOTAL		\$125.19						
		Frame Parts										
				https://v	www.thing	iverse.con	n/thing:4333	605				
41												
		Item		Qty	Cost	Total	Source	Source URL	Alternate Source URL	Notes	Additional Source URL	
וב		Solar Cell 5.5V 160mA 90mm x 80mm			Cost \$3.69	Total \$11.07	Source Aliexpress	Source URL https://www.aliexpress.com	https://www.amazon.com/	You only need 3 if you de	on't put one on the bottom -Z side	⟨side
)][1 11		Qty 3	Cost	Total \$11.07 \$1.78	Source Aliexpress	Source URL	https://www.amazon.com	You only need 3 if you do Two small solar cells on	on't put one on the bottom -Z side either side of the camera on the ->	(side
		Solar Cell 5.5V 160mA 90mm x 80mm Solar Cell 5.5V 40mA 57mm x 28mm		Qty 3 2	\$3.69 \$0.89	Total \$11.07 \$1.78	Source Aliexpress Aliexpress	Source URL https://www.aliexpress.cor https://www.aliexpress.cor	https://www.amazon.com/	You only need 3 if you do Two small solar cells on For taking photos for SS	on't put one on the bottom -Z side either side of the camera on the ->	(side
		Solar Cell 5.5V 160mA 90mm x 80mm Solar Cell 5.5V 40mA 57mm x 28mm Pi Camera for Pi Zero with 6" cable		Qty 3 2 1	\$3.69 \$0.89 \$9.99	Total \$11.07 \$1.78 \$9.99	Source Aliexpress Aliexpress Amazon	Source URL https://www.aliexpress.cor https://www.aliexpress.com/A	https://www.amazon.com/ https://www.amazon.com/ https://www.amazon.com/	You only need 3 if you do Two small solar cells on For taking photos for SS For -X side	on't put one on the bottom -Z side either side of the camera on the ->	(side
		Solar Cell 5.5V 160mA 90mm x 80mm Solar Cell 5.5V 40mA 57mm x 28mm Pi Camera for Pi Zero with 6" cable Solar Cell 5.5V 160mA 90mm x 80mm Solar Cell 5V 150mA 90mm x 70mm Velcro thin clear fasteners		Qty 3 2 1 1 2 1	\$3.69 \$0.89 \$9.99 \$2.00 \$2.00 \$2.95	\$11.07 \$1.78 \$9.99 \$0.00 \$4.00 \$2.95	Source Aliexpress Aliexpress Amazon Aliexpress Amazon	Source URL https://www.aliexpress.cor https://www.aliexpress.cor https://www.aliexpress.cor https://www.aliexpress.cor https://www.aliexpress.cor https://www.aliexpress.cor	https://www.amazon.com/ https://www.amazon.com/ https://www.amazon.com/ https://www.amazon.com/ p/product/B0013AO2PA/	You only need 3 if you do Two small solar cells on For taking photos for SS For -X side Choose 90x70mm *colo With the new frame, per	on't put one on the bottom -Z side either side of the camera on the -X ETV ** For +X side and +Z side manent mounting of solar panels is	s problematic,
		Solar Cell 5.5V 160mA 90mm x 80mm Solar Cell 5.5V 40mA 57mm x 28mm Pi Camera for Pi Zero with 6" cable Solar Cell 5.5V 160mA 90mm x 80mm Solar Cell 5V 150mA 90mm x 70mm Velcro thin clear fasteners JST RCY 2 Pin Connector Plug Lead Wire 22A		Qty 3 2 1 1 2 1 1	\$3.69 \$0.89 \$9.99 \$2.00 \$2.00 \$2.95 \$5.98	\$11.07 \$1.78 \$9.99 \$0.00 \$4.00 \$2.95 \$5.98	Source Aliexpress Aliexpress Amazon Aliexpress Aliexpress Amazon Amazon	Source URL https://www.aliexpress.cor https://www.aliexpress.cor https://www.aliexpress.cor https://www.aliexpress.cor https://www.aliexpress.cor https://www.amazon.com/ https://www.amazon.com/ https://www.amazon.com/	https://www.amazon.com/ https://www.amazon.com/ https://www.amazon.com/ https://www.amazon.com/ p/product/B0013AO2PA/ https://es.aliexpress.com/	You only need 3 if you do Two small solar cells on For taking photos for SS For -X side Choose 90x70mm "colo With the new frame, per 10 pack. Always make s	on't put one on the bottom-Z side either side of the camera on the -> TV r' For +X side and +Z side manent mounting of solar panels is ure the polarity red/black is correct	s problematic,
		Solar Cell 5.5V 160mA 90mm x 80mm Solar Cell 5.5V 40mA 57mm x 28mm Pi Camera for Pi Zero with 6° cable Solar Cell 5.5V 160mA 90mm x 80mm Solar Cell 5V 150mA 90mm x 70mm Velcro thin clear fasteners JST RCY 2 Pin Connector Plug Lead Wire 22A Micro JST 2 pin wires and connectors		Qty 3 2 1 1 2 1 1 1	\$3.69 \$0.89 \$9.99 \$2.00 \$2.00 \$2.95 \$5.98 \$5.99	\$11.07 \$1.78 \$9.99 \$0.00 \$4.00 \$2.95 \$5.98 \$5.99	Source Aliexpress Aliexpress Amazon Aliexpress Amazon Amazon Amazon Amazon	Source URL https://www.aliexpress.com https://www.aliexpress.com https://www.aliexpress.com https://www.aliexpress.com https://www.aliexpress.com https://www.amazon.com/g https://www.amazon.com/d https://www.amazon.com/d	https://www.amazon.com/ https://www.amazon.com/ https://www.amazon.com/ https://www.amazon.com/ p/product/B0013AO2PA/ https://es.aliexpress.com/	You only need 3 if you do Two small solar cells on For taking photos for SS For -X side Choose 90x70mm "colo With the new frame, per 10 pack. Always make s 20 pack. Always make s	on't put one on the bottom-Z side either side of the camera on the -> TV 'For +X side and +Z side manent mounting of solar panels is ure the polarity red/black is correc ure the polarity red/black is correc ure the polarity red/black is correc	s problematic, t before wiring t before wiring
		Solar Cell 5.5V 160mA 90mm x 80mm Solar Cell 5.5V 40mA 57mm x 28mm P1 Camera for P1 Zero with 6" cable Solar Cell 5.5V 160mA 90mm x 80mm Solar Cell 5.V 150mA 90mm x 70mm Velcro thin clear fasteners JST RCY 2 Pin Connector Plug Lead Wire 22A Micro JST 2 pin wires and connectors Heat shrink pieces for cables		Qty 3 2 1 1 2 1 1 2 1 8	\$3.69 \$0.89 \$9.99 \$2.00 \$2.00 \$2.95 \$5.98 \$5.99 \$0.16	\$11.07 \$1.78 \$9.99 \$0.00 \$4.00 \$2.95 \$5.98 \$5.99 \$1.28	Source Aliexpress Aliexpress Amazon Aliexpress Aliexpress Amazon Amazon Amazon Digikey	Source URL https://www.aliexpress.com/https://www.aliexpress.com/https://www.aliexpress.com/thtps://www.aliexpress.com/thtps://www.aliexpress.com/thtps://www.amazon.com/ghttps://www.amazon.com/dhttps://www.amazon.com/dhtps://www.	https://www.amazon.com/ https://www.amazon.com/ https://www.amazon.com/ o/product/B0013AO2PA/ https://es.aliexpress.com/ https://es.aliexpress.com/	You only need 3 if you di Two small solar cells on For taking photos for SS For -X side Choose 90x70mm "colo With the new frame, per 10 pack. Always make s 20 pack. Always make s Cut in half and use on re	ont put one on the bottom -Z side either side of the camera on the -X TV "For +X side and +Z side manent mounting of solar panels is ure the polarity red/black is correc ure the polarity red/black is correc d and black leads for each connec	s problematic t before wirin t before wirin tor, use heat (
		Solar Cell 5.5V 160mA 90mm x 80mm Solar Cell 5.5V 40mA 57mm x 28mm Pi Camera for Pi Zero with 6° cable Solar Cell 5.5V 160mA 90mm x 80mm Solar Cell 5V 150mA 90mm x 70mm Velcro thin clear fasteners JST RCY 2 Pin Connector Plug Lead Wire 22A Micro JST 2 pin wires and connectors		Qty 3 2 1 1 2 1 1 1	\$3.69 \$0.89 \$9.99 \$2.00 \$2.00 \$2.95 \$5.98 \$5.99	\$11.07 \$1.78 \$9.99 \$0.00 \$4.00 \$2.95 \$5.98 \$5.99	Source Aliexpress Aliexpress Amazon Aliexpress Amazon Amazon Amazon Amazon	Source URL https://www.aliexpress.com https://www.aliexpress.com https://www.aliexpress.com https://www.aliexpress.com https://www.aliexpress.com https://www.amazon.com/g https://www.amazon.com/d https://www.amazon.com/d	https://www.amazon.com/ https://www.amazon.com/ https://www.amazon.com/ o/product/B0013AO2PA/ https://es.aliexpress.com/ https://es.aliexpress.com/	You only need 3 if you di Two small solar cells on For taking photos for SS For -X side Choose 90x70mm "colo With the new frame, per 10 pack. Always make s 20 pack. Always make s Cut in half and use on re	on't put one on the bottom-Z side either side of the camera on the -> TV 'For +X side and +Z side manent mounting of solar panels is ure the polarity red/black is correc ure the polarity red/black is correc ure the polarity red/black is correc	s problematic t before wirin t before wirin tor, use heat (
		Solar Cell 5.5V 160mA 90mm x 80mm Solar Cell 5.5V 40mA 57mm x 28mm PI Camera for PI Zero with 6" cable Solar Cell 5.5V 160mA 90mm x 80mm Solar Cell 5V 150mA 90mm x 70mm Velcro thin clear fasteners JST RCV 2 Pin Connector Plug Lead Wire 22A Micro JST 2 pin wires and connectors Heat shrink pieces for cables GPIO 20x2 female stacking header extra long		Qty 3 2 1 1 2 1 1 2 1 1 2 2 2 2 2 3 3 4 4 4 5 6 6 7 8 8 2	\$3.69 \$0.89 \$9.99 \$2.00 \$2.00 \$2.95 \$5.98 \$5.99 \$0.16	\$11.07 \$1.78 \$9.99 \$0.00 \$4.00 \$2.95 \$5.98 \$5.99 \$1.28 \$5.00	Source Aliexpress Aliexpress Amazon Aliexpress Amazon Amazon Amazon Digikey Adafruit	Source URL https://www.aliexpress.com/ https://www.aliexpress.com/ https://www.amazon.com/ https://www.amazon.com/ https://www.amazon.com/ https://www.amazon.com/ ohttps://www.amazon.com/ https://www.amazon.com/ https://www.amazon.com/ https://www.amazon.com/ https://www.amazon.com/ https://www.amazon.com/ https://www.amazon.com/ohttps://ww	https://www.amazon.com/ https://www.amazon.com/ https://www.amazon.com/ o/product/B0013AO2PA/ https://es.aliexpress.com/ https://es.aliexpress.com/	You only need 3 if you di Two small solar cells on For taking photos for SS For-X side Choose 90x70mm 'colo With the new frame, pen 10 pack. Always make s 20 pack. Always make s Cut in half and use on re Don't buy the most com 240 pieces M2.5 black	ont put one on the bottom -Z side either side of the camera on the -X TV "For +X side and +Z side manent mounting of solar panels is ure the polarity red/black is correc ure the polarity red/black is correc d and black leads for each connec	s problematic t before wirin t before wirin tor, use heat of exact ones
		Solar Cell 5.5V 160mA 90mm x 80mm Solar Cell 5.5V 40mA 57mm x 28mm Pt Camera for Pt Zero with 6" cable Solar Cell 5.5V 150mA 90mm x 80mm Solar Cell 5.V 150mA 90mm x 70mm Velcro thin clear fasteners JST RCY 2 Pin Connector Plug Lead Wire 22A Micro JST 2 pin wires and connectors Heat shrink pieces for cables GPI0 20x2 female stacking header extra long M2.5mm 240 pieces black standoffs 3D Printed Frame (4 parts) Mounting squares 1"x1"		Qty 3 2 1 1 2 1 1 8 2 1 1 1 1 8 1 1 1 1 1 1 1	\$3.69 \$0.89 \$9.99 \$2.00 \$2.00 \$2.95 \$5.98 \$5.99 \$0.16 \$2.50 \$11.99	\$11.07 \$1.78 \$9.99 \$0.00 \$4.00 \$2.95 \$5.98 \$5.99 \$1.28 \$5.00 \$11.99	Source Aliexpress Aliexpress Amazon Aliexpress Aliexpress Amazon	Source URL https://www.aliexpress.com https://www.aliexpress.com https://www.aliexpress.com https://www.aliexpress.com https://www.aliexpress.com https://www.amazon.com/g https://www.amazon.com/d /products/detail/alpha-wirn https://www.amazon.com/g https://www.amazon.com/g https://www.amazon.com/g https://www.amazon.com/g https://www.amazon.com/g https://www.amazon.com/g	https://www.amazon.com/ https://www.amazon.com/ https://www.amazon.com/ o/product/B0013AO2PA/ https://es.aliexpress.com/ https://es.aliexpress.com/	You only need 3 if you di Two small solar cells on For taking photos for SS For-X side Choose 90x70mm 'colo With the new frame, pen 10 pack. Always make s 20 pack. Always make s Cut in half and use on re Don't buy the most com 240 pieces M2.5 black	on't put one on the bottom-Z side either side of the camera on the -> TV **For +X side and +Z side manent mounting of solar panels is ure the polarity red/black is correcure the polarity red/black is correcure the polarity red/black is correcured to the polarity red/black is correcured to the polarity red/black is correcured to monone sthat are taller than these	s problematic t before wirin t before wirin tor, use heat of exact ones
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_		10k resistor		3	\$0.10	\$0.30	Digikey	https://www.digikey.com/pro					
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					\$10.00	\$10.00		inceps, / www.amsac.org/pro		Gerbers are available off G	iti idb to iliake you	OWITT CD3 Http3.//	gittiub.com/alanbj
				TOTAL		\$54.13							
		Ground Station		https://g	ithub.com/a	alanbjohns	ston/CubeSa	tSim/wiki/3Ground-Station					
lacksquare		Item		Qty		Total	Source	Source URL	Alternate Source URL	Notes	Additional Sou	rce URL	
		Alt 6a: Your PC with RTL-SDR	\leq	1	\$29.95	\$29.95	Amazon	https://www.amazon.com/	https://www.ebay.com/itm	Other SDRs will work as	well		
		Alt 6a: SMA Antenna for 433 MHz right angle	d	1	\$5.33	\$5.33	Digikey	https://www.digikey.com/pro		Most low cost versions a	are fakes and are	n't reconant at 421	2 MALLIN
_			-			70.00				INDUCTION COOL VOIGIONS C	are rance and are	in the somanit at 430	3 IVITZ
		Alt 6b: Raspberry Pi 4 ground station		1	\$105.00	\$0.00	Amazon	https://www.amazon.com/		INCOCION COCC VOIGIONO	iro ianos ana aro	ir resonant at 45	3 IVITZ
		Alt 6b: Raspberry Pi 4 ground station Alt 6b: Pi 4 power supply		1	\$105.00 \$8.99	\$0.00 \$0.00	Amazon Amazon	https://www.amazon.com/ https://www.amazon.com/					
		Alt 6b: Raspberry Pi 4 ground station Alt 6b: Pi 4 power supply Alt 6b: micro SD card 16 GB with FIABv3			\$105.00 \$8.99 \$20.00	\$0.00 \$0.00 \$0.00	Amazon Amazon Amazon	https://www.amazon.com/	https://www.amazon.con				
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		Alt 6b: Raspberry Pi 4 ground station Alt 6b: Pi 4 power supply Alt 6b: micro SD card 16 GB with FIABv3 Alt 6b: RTL-SDR Alt 6b: SMA Antenna for 433 MHz right angle		1 1 1	\$105.00 \$8.99 \$20.00 \$24.95 \$5.33	\$0.00 \$0.00 \$0.00 \$0.00 \$0.00	Amazon Amazon Amazon Amazon Digikey	https://www.amazon.com/ https://www.amazon.com/ https://www.amsat.org/prod		Any 16GB or larger card	can be used with	free download of	Fox-in-a-Box v3 i
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		Alt 6b: Raspberry PI 4 ground station Alt 6b: PI 4 power supply Alt 6b: micro SD card 16 GB with FIABv3 Alt 6b: RTL-SDR Alt 6b: RTL-SDR Alt 6b: STA Antenna for 433 MHz right angle Alt 6b: 7 touchscreen with speakers and sta		1 1 1 1 1	\$105.00 \$8.99 \$20.00 \$24.95 \$5.33 \$84.99 \$10.33	\$0.00 \$0.00 \$0.00 \$0.00 \$0.00 \$0.00 \$0.00	Amazon Amazon Amazon Amazon Digikey Amazon Amazon	https://www.amazon.com/ https://www.amazon.com/ https://www.amsat.org/prod https://www.amazon.com/ https://www.digikey.com/pro https://www.amazon.com/g https://www.amazon.com/g		Any 16GB or larger card Other SDRs will work as	can be used with	free download of	Fox-in-a-Box v3 i
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