Input voltage	3V to 4.5V	3 AA batteries
vibration motors	2	PWM 7 steps + off
IR coms	1 Tx/Rx pair	38kHz 8N1 2994 baud
RGB leds	4 tripplets	2 bit PWM per color + 2 bit blink per led
Shitty addon	1	Wired but not populated or used in current firmware
Badgebus	1	Wired but not populated or used in current firmware
Micro	1	PIC16F15355

					55		$10.03	$551.68	< parts only see total below for other supplies
Item	price per unit	pcs per unit			Q		extended	link	
Pager motors	$23.88	100	$0.24	2	2	110	$0.48		
PIC	$26.01	25	$1.04	1	1	55	$1.04	https://www.digikey.com/product-detail/en/microchip-technology/PIC16F15355-I-SS/PIC16F15355-I-SS-ND/6244561	
RGB led	$79.94	100	$0.80	4	4	220	$3.20	https://www.digikey.com/product-detail/en/sunled/XZMDKCBDDG45S-9/1497-1257-1-ND/5169746	
googly eyes 1cm	$2.54	100	$0.03	2	2	110	$0.05		
10.2k R	$0.60	100	$0.01	11	11	605	$0.07	https://www.digikey.com/product-detail/en/yageo/RC0603FR-0710K2L/311-10.2KHRCT-ND/729830	
200 R	$0.69	100	$0.01	4	4	220	$0.03	https://www.digikey.com/product-detail/en/stackpole-electronics-inc/RMCF0603FT200R/RMCF0603FT200RCT-ND/1942972	
100 R	$0.69	100	$0.01	8	8	440	$0.06	https://www.digikey.com/product-detail/en/stackpole-electronics-inc/RMCF0603FT100R/RMCF0603FT100RCT-ND/1942965	
diode	$0.92	10	$0.09			0	$0.00	https://www.digikey.com/product-detail/en/taiwan-semiconductor-corporation/LS4148-L1G/LS4148L1GCT-ND/7357787	
N Fet	$10.98	100	$0.11	3	3	165	$0.33	https://www.digikey.com/product-detail/en/rohm-semiconductor/RK7002BMT116/RK7002BMT116CT-ND/5042538	
IR led	$0.19	1	$0.19	1	1	55	$0.19	https://www.digikey.com/product-detail/en/tt-electronics-optek-technology/OP181/365-1982-1-ND/5225747	
20 R 1206	$0.52	10	$0.05	1	1	55	$0.05	https://www.digikey.com/product-detail/en/stackpole-electronics-inc/RNCP1206FTD20R0/RNCP1206FTD20R0CT-ND/2240645	
IR sensor	$16.88	25	$0.68	1	1	55	$0.68	https://www.digik	https://www.digikey.com/product-detail/en/vishay-semiconductor-opto-division/TSOP38538/TSOP38538-ND/4695639
Shitty conn	$5.48	10	$0.55	1	0	0	$0.00	https://www.digikey.com/product-detail/en/sullins-connector-solutions/PPPC022LFBN-RC/S7105-ND/810242	
Badge bus	$6.38	10	$0.64	1	0	0	$0.00	https://www.digikey.com/product-detail/en/amphenol-fci/10120045-401LF/609-5015-1-ND/5731726	
battery holder	$0.50	1	$0.50	1	1	55	$0.50		
fur	$26.95	50	$0.54	1	1	55	$0.54	https://www.etsy.com/listing/593695207/rainbow-tie-dye-fur-rainbow-faux-fur?gpla=1&gao=1&&utm_source=google&utm_medium=cpc&utm_campaign=shopping_us_b-craft_supplies_and_tools-fabric_and_notions-fabric&utm_custom1=ae0de536-eabc-4705-8329-8b7bbc9e66cb&gclid=EAIaIQobChMInoLV0L-42wIVghkCh1e3QZSEAkYASABEgKI3fD_BwE	
0.1uF 0805	$2.62	100	$0.03	2	1	55	$0.03	https://www.digikey.com/product-detail/en/yageo/CC0805ZRY5V9BB104/311-1361-1-ND/2103145	
22uF 0805	$14.52	100	$0.15	5	1	55	$0.15	https://www.digikey.com/product-detail/en/samsung-electro-mechanics/CL21A226MOCLRNC/1276-6780-1-ND/5961639	
PCBs	$132.92	50	$2.66	1	1	55	$2.66		

	714.56	54	13.23259259
Proto PCBs	39.75	< OSH park	
digikey parts	32.17		
Digikey parts	$377.22		
PCBs	$132.92		
stickers	$9.50	< used for masking during spray gluing	
super 77	$10.78		
Pager motors	$23.88		
googly eyes 1cm	$2.54		
fur	$26.95		
Double stick tape	$4.00	< used for attaching the battery holders	
more eyes	$1.01		
more pagers	$3.84		
Battery holders	$50.00		
Masking tape	?	< used for masking during spray gluing	
Lanyards	?	< lost the invoice	
Labor	?	< way too much :) all hand assembled including parts placement.	

Catagory	item	notes	priority	Status	more notes	Items marked lost were in the final firmware on the badges. But I forgot to copy the source files up before wiping my laptop post defcon :(
IR	becon			done		
IR	direct remote			done	ish continous button detection is really iffy could be better	
IR	set mode reg			done	8 bits mode	
IR	vibe control			done		
IR	set custom color			done	12 bit select. first 2 bits selects the led to update, next bit not used, then 8 bits led value, then 1 bit not used.	
Leds	bin count	multi color		done		
Leds	bin count	custom color		done		
Leds	bin count	bit order swapped		done		
Leds	cycle	walk though all the options...		Lost		
Leds	Fixed color			done		
Leds	Larson	custom color		done	Use values from fixed color led 4 and 3 for the main dot and the trailer	
Leds	Larson	2 swipe color change		done		
Leds	Larson	Full rainbow per dot		done	first dot as cycled. Second dot previous cycle and 0x15	
Leds	rainbow	left		done		
Leds	rainbow	right		done		
Leds	Random LFSR			done		
Leds	Larson	1 swipe color change		done		
other	save to flash			done		
vibe	base code			done		
Leds	morse code	ride me		done		
Leds	morse code	bounus		Lost	hidden message at upper offset	
other	beacon disable			done	just disable rcv not sends. Ok if reset on use of remote control reg..	
vibe	more patterns			Lost		
vibe	cycle			Lost		

		Bit order reading leds left to right [b = 11, g = 10, r = 9][b = 8, g = 7, r = 6][b = 5, g = 4, r = 3] [b = 2, g = 1, r = 0]				
	rmt	mode register (8 bit)	function	width	notes	
ok	y	0	display mode	8	default reg for all	unimplemented values
ok					0	rainbow left
ok					1	rainbow right
ok					2	static custom color (pick color with mode reg 2 per led and blink setting with mode reg 3 per led)
ok					3	LFSR blink (as random as I can get)
ok					4	Larson scanner using custom colors (right LED leading dot, middle right trailing dot)
ok					5	Larson scanner RGB 1 direction per color
ok					6	Larson scanner RGB 2 directions per color
ok					7	Larson scanner Rainbow per led
ok					8	Ride me custom color (right LED)
ok					9	Ride me rainbow led
ok					a	Count LSB L custom colors
ok					b	Count LSB L rainbow same per set
ok					c	Count LSB L rainbow different per led on
ok					d	Count LSB R custom colors
ok					e	Count LSB R rainbow same per set
ok					f	Count LSB R rainbow different per led on
lost					10	cycle through all above
lost					AA	you are dedicated rainbow
ok	y	1	display speed	12	Sets the clock multiplyer for how fast the animation delay loops run	
ok	y	2	custom colors	24	6 bits per led	
ok	y	3	custom blink	8	2 bits per led	
ok	y	4	vibe pattern	8	Selecting a pattern will start a run of that pattern when final set is pressed	
ok					0	simple up down 1 motor no stop
lost					1	simple up down 1 motor with stop
lost					2	ramp up motor 1, then motor 2, motor 1 down, motor 2 down, stop
lost					3	ramp up cliff
lost					4	ramp down cliff
lost					5	ping pong
lost					6	ping off pong off
lost					7	ramp bounce
lost					8	ride me
lost					9	oh yea
lost					a	twinlke
lost					b	cycle through all above
ok	n	5	vibe loop cnt	8	Above pattern will repeat this many times after the inital run (0 not valid and will run the loop once)	

		Bit order reading leds left to right [b = 11, g = 10, r = 9][b = 8, g = 7, r = 6][b = 5, g = 4, r = 3] [b = 2, g = 1, r = 0]									
	rmt	mode register (8 bit)	function	width	notes						
ok	y	6	vibe speed	12	Sets the clock multiplyer for how fast the vibe loops run						
ok	n	7	save settings	0	second set saves var when chosen						
ish	y	8	direct remote	0	after second set A / B buttons trigger remote motor set exits						
ok	-	9	rmt display mode	8	changes all remote badges to chosen pattern that are in IR range.						
ok	-	A	rmt speed l		change all remote badges in IR range LSB of animation speed						
ok	-	B	rmt speed h		change all remote badges in IR range MSB of animation speed (masked to 4 lsb for 12 bits total)						
ok	-	C	rmt LED1		change all remote badges in IR range custom LED1 (2 bits blink, 2 bits blue, 2 bits green, 2 bits red - bit order 7 - 0)						
ok	-	D	rmt LED2		change all remote badges in IR range custom LED2						
ok	-	E	rmt LED3		change all remote badges in IR range custom LED3						
ok	-	F	rmt LED4		change all remote badges in IR range custom LED4						
ok	-	10	rmt vibe		change all remote badges in IR range set vibe pattern and start a single cycle						
ok	-	11	rmt vibe spd l		change all remote badges in IR range LSB of vibe speed						
ok	-	12	rmt vibe spd h		change all remote badges in IR range MSB of vibe speed (masked to 4 lsb for 12 bits total)						
ok		13	beacon rcv off		bit 1 enables / disable the beacon vibe pulse. Rest to on after direct remote use						

IR 8N1 2994 baud							
frame structure							
M	S	[cmd]	[badge id]	[data]	[checksum]		
0x4D	0x53	..	..	..	..		
1001101	1010011						
The checksum should be set such when all bytes of the frame are added to gether and ANDed with 0xFF the result is 0							
Command	data		notes				
0	not used		if the badge ID rcvd is not = to this badge pulse M2				
1	bit 0 = MT1, bit 1 = MT2						
2	reg value		set badge display mode to this value				
3	reg value		set LSB of animation speed				
4	reg value		set MSB of animation speed (masked to 4 lsb for 12 bits total)				
5	reg value		set custom LED1 (2 bits blink, 2 bits blue, 2 bits green, 2 bits red - bit order 7 - 0)				
6	reg value		set custom LED2				
7	reg value		set custom LED3				
8	reg value		set custom LED4				
9	reg value		set and start a single cycle of vibe pattern				
A	reg value		set LSB of vibe speed				
B	reg value		set MSB of vibe speed (masked to 4 lsb for 12 bits total)				

LED current calcs at various battery voltages										
1.3	3	3.9								
red										
4.5	1.88	2.62	190	0.01378947368	12	0.1654736842				
3.5	1.88	1.62	190	0.008526315789	12	0.1023157895				
3	1.88	1.12	190	0.005894736842	12	0.07073684211				
3	1.88	1.12	0.006	186.6666667						
green										
4.5	2.94	1.56	100	0.0156	12	0.1872				
3.5	2.94	0.56	100	0.0056	12	0.0672				
3	2.94	0.06	100	0.0006	12	0.0072				
3	2.94	0.06	0.006	10						
blue										
4.5	3	1.5	100	0.015	12	0.18				
3.5	3	0.5	100	0.005	12	0.06				
3	3	0	100	0	12	0				
3	3	0	0.006	0						
38kHz timer 2 calc					max PBS based on min number of pluses			baud rate		
32	MHz	system clock			0.000026375	pulse length s		32	MHz	
32000000	Hz				12	pulses per bit		32000000	Hz	
8000000	Hz	instruction clock			0.0003165	bit lenght s		64	divider	64, 16, 4
D3					3159.557662	max BPS		3000	target baud	
211		20	10.55	A				165.6666667	result N	
37914.69194	Hz							166	N	
37.91469194	kHz	-0.22%						2994.011976	baud	
								-0.20%	% error	
								A6	N hex	
Timer 0 calc for PWM of LEDs and main timing loop										
31	kHz		60	Hz eye target						
31000	hz		3	slices						
0	pre scale	1	180	Hz IRQ freq						
31000	hz									
AC	PR2									
172										
180.2325581										

31000	hz									
180	hz target									
172.2222222										
172										
AC	PR2 hex									
-0.13%										
Delay calculator for TMR0 based values										
0.005548387097	TMR0 period s									
65535	max count									
363.6135484	max delay s									
6.060225806	max delay min									
255	max count									
1.41483871	max delay s									
0.5	target delay in s									
90.11627907	tics									
90	tics									
5A	hex tics									
2d	hex tics									
45	tics									
0.2496774194	s									