

cyclcr.txt

Parts list for Cyclcr

C1-3	100uF 25vdc electrolytic	Jameco 93761	\$0.07ea	\$0.21
C4-7	4.7uF 25vdc electrolytic	Jameco 31000	\$0.035ea	\$0.14
C8-12	0.1uF 50v ceramic capacitor	BGMicro CAP1130	\$0.03ea	\$0.15
C13-15	0.022uF 100v ceramic capacitor	Jameco 15229	\$0.049ea	\$0.147
C16	4700pF 5% 100v COG ceramic	Mouser 810-FK24C0G2A472J		\$0.24
C17-19	1000pF 100v ceramic capacitor	Jameco 544825	\$0.059ea	\$0.177
C20-23	22pF 100v ceramic capacitor	Jameco 15407 DC22	\$0.034ea	\$0.136
D1-3	1N4746A 18v 1w zener diode	Mouser 776-1N4746A-T/R	\$0.08ea	\$0.24
D4	1N5818 30v 1a schottky diode	Jameco 177957		\$0.07
D5	1N5252B 51v 0.5w zener diode	Mouser 78-1N5262B		\$0.03
D6	1N5231B 5.1v 0.5w zener diode	Mouser 78-1N5231B	\$0.03ea	\$0.03
D7-11	1N4148 signal diode	Jameco 179215	\$0.012ea	\$0.06
D12,13	red T1-3/4 LED	MPJA 15108-OP	\$0.0195ea	\$0.04
D14	green T1-3/4 LED	MPJA 15308-OP	\$0.0195ea	\$0.02
F1	3AG or AGC 0.5a 250v fuse	Jameco 10410		\$0.19
L1	common mode choke, 2x3.3mH	BGMicro COL1065		\$0.20
Q1-6	2N3906 PNP signal transistor	Jameco 783455	\$0.33/10	\$0.098
Q7-9	2N7000 MOSFET signal transistor	Jameco 1217519 BS170	\$0.076ea	\$0.228
Ra-f	100k potentiometer, 1-turn	BGMicro RES1047	\$0.99ea	\$5.94
Rg-i	20k trimpot, 1 turn	BGMicro RES1421	\$0.15ea	\$0.45
Rj,k	1meg trimpot, 1 turn	BGMicro RES1425	\$0.15ea	\$0.30
R1	1 ohm 5% 1/4w resistor	Mouser 660-CF1/4C1R0J		\$0.01
R2,3	47 ohm 5% 1/4w carbon film	Jameco 690540	\$1/100	\$0.02
R4-8	1k ohm 5% 1/4w carbon film	Jameco 690865	\$1/100	\$0.05
R9,10	2.2K ohm 5% 1/4w carbon film	Jameco 30314	\$0.79/100	\$0.0158
R11,12	3.9K ohm 5% 1/4w carbon film	Jameco 691008	\$1/100	\$0.02
R13,14	6.8K ohm 5% 1/4w carbon film	Jameco 691067	\$1/100	\$0.02
R15,16	8.2K ohm 5% 1/4w carbon film	Jameco 691083	\$1/100	\$0.02
R17-23	10k ohm 1% 1/4w metal film	Mouser 272-10K-RC	\$4/200	\$0.14
R24,25	18K ohm 5% 1/4w carbon film	Jameco 691163	\$1/100	\$0.02
R26-31	20k ohm 1% 1/4w metal film	Mouser 272-20K-RC	\$4/200	\$0.12
R32,33	27K ohm 5% 1/4w carbon film	Jameco 691201	\$1/100	\$0.02
R34-36	47K ohm 5% 1/4w carbon film	Jameco 691260	\$1/100	\$0.03
R37	68K ohm 5% 1/4w carbon film	Jameco 691307	\$1/100	\$0.01
R38-47	100k ohm 1% 1/4w metal film	Mouser 272-100K-RC	\$4/200	\$0.20
R48-55	150k ohm 1% 1/4w metal film	Mouser 272-150K-RC	\$4/200	\$0.16
R56-59	270K ohm 5% 1/4w carbon film	Jameco 30613	\$0.79/100	\$0.0316
R60,61	400k ohm 1% 1/4w metal film	Mouser 272-400K-RC	\$4/200	\$0.04
R62	1meg ohm 5% 1/4w carbon film	Jameco 691585	\$1/100	\$0.01
R63-68	2meg ohm 5% 1/4w carbon film	Jameco 691649	\$1/100	\$0.05
S1,2	SPST switch, PC mount, C&K 7101	BGMicro SWT1004	\$0.20ea	\$0.40
S3	4-pole DIP switch	BGMicro SWT1129		\$0.40
U1	MC34063 switching regulator	Jameco 316945		\$0.66
U2	LP2950ACN low dropout regulator	Jameco 1944880		\$0.29
U3	TL074CN quad FET opamp	Jameco 33216		\$0.39
U4	LM339N quad comparator	Jameco 23851		\$0.19
U5,6	TL431 shunt regulator	Mouser 512-LM431ACZX	\$0.12ea	\$0.24
U7	CD4030 quad XOR gate	Jameco 676019		\$0.179
U8,9	CD4536 programmable timer	Jameco 676449	\$0.29ea	\$0.58
U10,11	CD4060 oscillator/divider	Jameco 894649	\$0.221ea	\$0.442
	or 74HC4060 oscillator/divider	Jameco 910101	\$0.36ea	
Y1	1.8432MHz crystal	BGMicro CRY18432		\$0.50

Total \$14.05

off-board parts

F01	ANL fuse, 100a	MPJA 14999-FU		\$3.49
Q01,02	CM200DV-12H dual 600v 200a IGBT	module or equiv. (Ebay)		\$20.00
Q03	2N3904 NPN transistor TO92	Jameco 1919810 2N3904RLRMG		\$0.024
RL	0.025 ohm (36" x 1/2" x 0.028"	steel banding strap)		\$0.00
RSa,b,c	0.005 ohm 1% 10w resistor	BGMicro RES1385	\$0.33ea	\$0.99
RT1,2	thermistor, 2k@25c, NTC-202	Jameco 207474	\$0.36ea	\$0.72

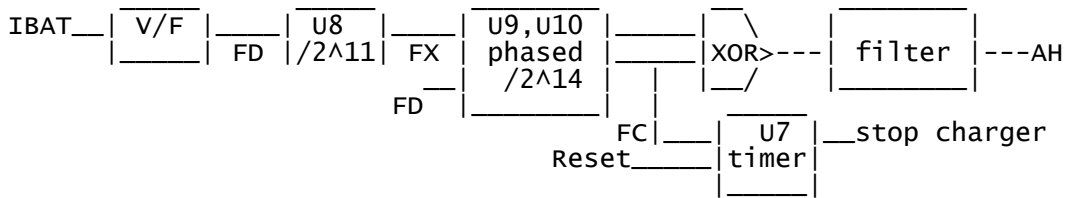
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				Total	----- \$25.22
simple display board					
D01	1N5234B	6.2v 0.5w zener diode	Mouser	78-1N5234B	\$0.03
M01	LCD	digital panel meter	BGMicro	MET1006	\$7.95
R01-02	1K ohm	5% 1/4w carbon film	Jameco	690865 \$1/100	\$0.02
S01	1-pole	12-pos rotary switch	Jameco	101532	\$1.29
				Total	----- \$9.29
microcomputer display board					
D01-04	MAN4640A	7-seg LED display	BGMicro	LED1113 \$0.39ea	\$1.56
R01-04	100 ohm	5% 1/4w resistor	Jameco	29946 \$0.79/100	\$0.032
U01	microcomputer	(PIC, Atmel)			\$3.00
S01-04	pushbutton	switch	Jameco	149948 \$0.19ea	\$0.76

Notes

Timers

part#	Jameco#	price	HC#	Jameco#	price	configuration
CD4024	12853	\$0.27				2^7
CD4536	676449	\$0.29				2^24 + osc
CD4040	12950	\$0.37	74HC4040	45903	\$0.056	2^12
CD4020	12802	\$0.49				2^14
CD4060	894649	\$0.221	74HC4060	910101	\$0.36	2^14 + osc
CD4541	13688	\$0.35				2^16 + osc



Charge timer U7

Goal: adjustable charge time up to 20 hours  
 20 hours x 3600 sec/hr = 72,000 sec

CD4536: number of clock pulses before each output goes high:

output:	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
pulses:	1	2	4	8	16	32	64	128	256	512	1024	2048	4096	8192	16384	32768
	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24								
	65536	131072	262144	524288	1048576	2097152	4194304	8388608								

If Q24 = 20 hours, then FC=8388608/72000 = 116.514 Hz.

AmpHour counter U9/U10

Use 4060 divider for U9 (/2^14) with xtal osc. so no trimpot is needed.  
 116.514 Hz x 2^14 = 1.908874 MHz. Use std 1.8432 MHz xtal (3.5% low).  
 Then FC = 1.8432 MHz / 2^14 = 112.5 Hz. Timing:

Q24 = 20.7 hours	} selected with a 3-pole DIP switch
Q23 = 10.35 hours	
Q22 = 5.17 hours	
Q21 = 2.6 hours	
Q20 = 1.3 hour	
Q19 = 39 minutes	
Q18 = 19 minutes	
Q17 = 9.7 min	

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Use 74HC4060 or CD4060 for U9/U10. CD4060 may not be fast enough for 1.8432 MHz; worst data sheet has 3.5 MHz typ, 1 MHz min freq at 5v.

### V/F converter

Goal: AH = 2.000v represents 200.0 amhours  
 $2^{14} = 16384$  counts.  $16384/2=8192$  counts for XOR to go from 0v to 5v.  
Filter has 100k/150k divider, so 5v from XOR is  $AH=5(150/(150+100))=3v$ .  
Full-scale (AH=5v) = 3v out = 300ah = 8192 counts.

Max current is 100a (IBAT=2.5v).  
Needs 8192 counts in 3 hours.  
So FX =  $8192c / 3h = 8192/(3 \times 3600) = 0.7585$  Hz at 100a  
If U8 divides by  $2^{11}$ , then V/Fmax = 1553 Hz at 100a  
1553hz = 321.9us low, 321.9us high.

Let IBAT(Rin)=20k. At IBAT=2.5v (100a),  $I_{n+}=I_{n-}=(2.5v/2)/20k=62.5ua$   
 $I=C(dv/dt)$  so  $C=(62.5ua)(321.9us) / 5v = 4024pf$   
Use 4700pf 5% COG ceramic from Battery Balancer  
TDK FK24C0G2A472J, 445-2598-ND \$0.352  
It's 14% high, so freq will be 14% low. Add trimpot to trim it.  
20k trimpot + 68k in output of U4C does it.

Use quad opamp with lower Ibias?

TL074BCN \$0.177 213065 Vos=2/3/5mv Ios=.05/.1/2na Ib=.065/.2/7na Vmin=V-+3v  
TL084ACN \$0.73 214084 Vos=3/6/7.5mv Ios=.05/.1/2na Ib=.03/.2/7na Vmin=V-+3v  
MC33174VP \$0.49 1944775 Vos=2.5/5/6mv Ios=5/20/40na Ib=20/100/200na Vmin=V-  
LT1014DN \$3.55 239177 Vos=.06/.3/1mv Ios=0.2/1.5/2.8na Ib=15/30/38na

capacitor	tempcos	-55c	-15c	15c	55c	95c	125c
polycarbonate		-2%	-1%	0	.5%	1.5%	2%
polyester		-4%	-2%	-.5%	+1.5%	+3.5%	
polypropylene		+1.5%	+1%	0	-.5%	-1%	-1.5%
polystyrene		+1%	+.5%	0	0		
polysulfone		-6%	-1%	0	0	8%	15%
teflon		+1%	0	0	0	-.5%	-1%

U9 divides V/F converter frequency by  $2^{11}$ .  
1553 Hz at 100a = 1 pulse every 1.31 sec.

### Power supply

#### 2N3906 performance

vbe=0.732v at 5ma, vce=0.078v at 5ma normal mode  
vbe=0.823v @ 5ma, vce=0.032v @ 5ma, 0.0033v @ 0ma inverted mode  
red LED MJPA (\$0.02 parts)  
vf=1.73v at 5ma