ModularEEG v1.1.0 - Bill of Materials

Digital board

Qty	Value	Package	Parts											
Capacitors														
1	27pF C0G	C-5	C102											
2	Cxtal	C-5	C115	C116										
3	10nF X7R	C-5	C108	C113	C119									
7	100nF X7R	C-5	C110	C111	C114	C117	C121	C124	C125	C131				
6	220nF 5%	C-5	C103	C104	C105	C106	C107	C109						
2	1µF tantalum	EL25B	C122	C123										
6	10µF tantalum	EL25B	C101	C120	C126	C127	C128	C129						
3	47µF tantalum	EL25B	C112	C118	C130									
Resistors														
1	100R	R-10	R111											
12	470R	R-10	R107	R114	R115	R116	R117	R118	R119	R120	R121	R122	R124	R128
5	1k	R-10	R125	R126	R127	R129	R130							
6	7.5k	R-10	R104	R106	R109	R110	R112	R113						
1	9k1	R-10	R103											
3	10k	R-10	R101	R105	R123									
1	15k	R-10	R102											
Discrete Semiconductors														
3	1N5818	D-12,5	D101	D103	D104									
1	LED 5mm	LED5	D102											
Integrated Circuits														
2	6N139	DIL-08	IC103	IC104										
1	7805	78XXL_S	IC107											
1	AT90S4433P	DIL-28/3	IC102											
1	MAX232	DIL-16	IC106											
1	TL431CLP	TO92-CLP	IC101											
1	TMV0505S	TMADCDC	IC105											
Miscellaneous Parts														
1	7.3728MHz	HC49/S	X101											
3	22µH	R-12,5	L101	L102	L103									
1	PINHD-2X5	2X05	J101											
1	PINHD-2X17	2X17	J102											

Analog board

Qty	Value	Package	Parts											
Capacitors														
2	10pF C0G	C-5	C209	C210										
4	100pF C0G	C-5	C204	C205	C206	C207								
6	1nF X7R	C-5	C212	C216	C222	C224	C232	C233						
2	10nF X7R	C-5	C202	C203										
2	33nF 5%	C-5	C234	C236										
12	100nF X7R	C-5	C208	C211	C214	C215	C217	C218	C219	C223	C225	C226	C227	C230
2	220nF 5%	C-5	C231	C235										
4	1µF film	C-10	C220	C221	C228	C229								
1	47µF tantalum	EL25B	C213											
1	47µF tan 1ohm	ES-5	C201											
Resistors														
1	100R	R-10	R240											
2	1k	R-10	R220	R222										
16	2k2	R-10	R201	R202	R203	R204	R205	R206	R207	R208	R209	R210	R211	R212
			R214	R215	R216	R217								
2	8.2k	R-10	R229	R234										
6	10k	R-10	R218	R219	R232	R237	R238	R239						
2	15k	R-10	R228	R233										
4	100k	R-10	R221	R225	R230	R235								
1	200k	R-10	R213											
6	1M	R-10	R223	R224	R226	R227	R231	R236						
Discrete Semiconductors														
4	BC547	TO92	Q205	Q206	Q207	Q208								
4	BC557	TO92	Q201	Q202	Q203	Q204								
Integrated Circuits														
2	INA114P	DIL-08	IC202	IC203										
4	TLC277P	DIL-08	IC201	IC204	IC205	IC206								
Miscellaneous Parts														
3	20k	S64Y	P201	P202	P203									
1	PINHD-2X17	2X17	J201											
170														

ModularEEG v1.1.0 - ordering information

All prices as of September 2002.

Color key:

See notes below.

See distributor-specific notes below..

No part is selected.

Not available. Prices given are estimates.

Value	Package	Qty D	Qty A	Qty D+A	Qty D+2A	Part requirements and notes	Newark Electronics Part no.	Newark Electronics Unit Price	Newark Electronics Min Qty	Newark Electronics ?	Digi-Key (USD) Part no.	Digi-Key (USD) Unit Price	Digi-Key (USD) Min Qty	Digi-Key (USD) ?
Capacitors														
10pF C0G	C-5		2	2	4	100V, 5mm pitch,C0G	50N1022	0,044	1					
Cxtal C0G	C-5	2		2	2	5mm pitch, C0G. **See notes.**	50N1028	0,044	1	1				
100pF C0G	C-5		4	4	8	100V, 5mm pitch, C0G	50N1068	0,044	1					
1nF X7R	C-5		6	6	12	200V, 5mm pitch, X7R	87F4719	0,142	1	2				
10nF X7R	C-5	3	2	5	7	100V, 5mm pitch, X7R	87F4724	0,123	1					
33nF 5%	C-5		2	2	4	5%, 5mm pitch, max 3.5mm wide	18C4841	0,236	1					
100nF X7R	C-5	8	12	20	32	50V, 5mm pitch, X7R	96F8771	0,122	1					
220nF 5%	C-5	6	2	8	10	5%, 5mm pitch, max 3.5mm wide	95B5780	0,108	1					
1µF film	C-10		4	4	8	5% tolerance, 10mm pitch	95B5792	0,325	1	3				
1µF tantalum	EL25B	2		2	2	35V, 2.5mm pitch	50N905	0,235	1					
10µF tantalum	EL25B	6		6	6	16V, 2.5mm pitch	50N883	0,459	1	4				
47µF tantalum	EL25B	3	1	4	5	> 6.3V, 2.5mm pitch	50N860	0,683	1	5				
47µF tan 1ohm	ES-5		1	1	2	> 6.3V, 5mm pitch, ESR = 0.8 - 1.2 ohm	95F4832	2,96	1	6				
Resistors														
100R	R-10	1	1	2	3	1% metal film, 0.25W, 10mm pitch	84N1686	0,031	1					
470R	R-10	12		12	12	1% metal film, 0.25W, 10mm pitch	84N1765	0,031	1					
1k	R-10	5	2	7	9	1% metal film, 0.25W, 10mm pitch	84N1712	0,031	1					
2k2	R-10		16	16	32	1% metal film, 0.25W, 10mm pitch	84N1737	0,031	1					
7.5k	R-10	6		6	6	1% metal film, 0.25W, 10mm pitch	84N1794	0,031	1					
8.2k	R-10		2	2	4	1% metal film, 0.25W, 10mm pitch	84N1799	0,031	1					
9k1	R-10	1		1	1	1% metal film, 0.25W, 10mm pitch	84N1804	0,031	1					
10k	R-10	3	6	9	15	1% metal film, 0.25W, 10mm pitch	84N1687	0,031	1					
15k	R-10	1	2	3	5	1% metal film, 0.25W, 10mm pitch	84N1702	0,031	1					
100k	R-10		4	4	8	1% metal film, 0.25W, 10mm pitch	84N1685	0,031	1					
200k	R-10		1	1	2	1% metal film, 0.25W, 10mm pitch	84N1720	0,031	1		OD204J-ND	0,42	1	1
1M	R-10		6	6	12	1% metal film, 0.25W, 10mm pitch	84N1719	0,033	1					
Discrete Semiconductors														
1N5818	D-12,5	3		3	3	Any 1A schottky should work.	09F4475	0,203	1					
BC547	TO92		4	4	8	TO92	92B7164	0,09	1					
BC557	TO92		4	4	8	TO92	18C5843	0,1	1					
LED 5mm	LED5	1		1	1	Any LED		0,3	1					
Integrated Circuits														
6N139	DIL-08	2		2	2	Optocoupler	09F7263	0,918	1		6N139QT-ND	0,95	1	
7805	78XXL_S	1		1	1	5V regulator, >= 500mA. Size TO220	34C1092	0,6	1		LM7805CT-ND	0,48	1	
AT90S4433P	DIL-28/3	1		1	1	**Will be replaced by ATmega8 soon.**	N/A	6,62	1		AT90S4433-8PI-ND	6,62	1	2
INA114AP	DIL-08		2	2	4	Low-power precision inamp	35C0480	8,02	1	9	INA114AP-ND	6,82	1	3
MAX232	DIL-16	1		1	1	RS232 tranceiver	34C3836	3,68	1	10	296-6940-5-ND	2,2	1	
TL431CLP	TO92-CLP	1		1	1	Adjustable voltage reference	08F9432	0,427	1		296-1290-ND	0,56	1	
TLC277P	DIL-08		4	4	7	Dual precision opamp	08F9096	1,67	1		296-1828-5-ND	1,55	1	
TMV0505S	TMADCDC	1		1	1	5Vin-5Vout 10% SIP7, 3kV iso	83F9263	11,3	1	11				
Miscellaneous Parts														
20k	S64Y		3	3	6	Multi-turn trimpot, 64Y footprint	67F5850	2,89	1		CT94Y203-ND	1,57	1	
22µH	R-12,5	3		3	3	SRF > 13MHz, Imax > 285mA, 12.5mm pitch	50H2891	0,2	1		DN41223-ND	1,33	1	
7.3728MHz	HC49/S	1		1	1	HC49 or equivalent package.	18C1524	0,546	1	1	X019-ND	0,64	1	
PINHD-2X17	2X17	1	1	2	3	2x17 pin-header / ribbon cable connector	90F4239	2,87	1		1-103186-7-ND	2,46	1	4
PINHD-2X5	2X05	1		1	1	2x5 pin-header / ribbon cable connector	95F1805	2,14	1		103240-5-ND	0,78	1	
Sockets														
8-pin socket	DIL-08	2	6	8	14		25C3677	0,06	1					
16-pin socket	DIL-16	1		1	1		03C3508	0,121	1					
28-pin socket	DIL-28	1		1	1	7.68mm wide.	26C0566	0,276	1					
Socket strip	SIL-20					Can be useful...								

Value	Newark Electronics Qty D	Newark Electronics Qty A	Newark Electronics Qty D+A	Newark Electronics Qty D+2A	Newark Electronics Price D	Newark Electronics Price A	Newark Electronics Price D+A	Newark Electronics Price D+2A	Digi-Key Qty D	Digi-Key Qty A	Digi-Key Qty D+A	Digi-Key Qty D+2A	Digi-Key Price D	Digi-Key Price A	Digi-Key Price D+A	Digi-Key Price D+2A
Capacitors																
10pF C0G		2	2	4		0,088	0,088	0,176								
Cxtal C0G	2		2	2	0,088		0,088	0,088								
100pF C0G		4	4	8		0,176	0,176	0,352								
1nF X7R		6	6	12		0,852	0,852	1,704								
10nF X7R	3	2	5	7	0,369	0,246	0,615	0,861								
33nF 5%		2	2	4		0,472	0,472	0,944								
100nF X7R	8	12	20	32	0,976	1,464	2,44	3,904								
220nF 5%	6	2	8	10	0,648	0,216	0,864	1,08								
1µF film		4	4	8		1,3	1,3	2,6								
1µF tantalum	2		2	2	0,47		0,47	0,47								
10µF tantalum	6		6	6	2,754		2,754	2,754								
47µF tantalum	3	1	4	5	2,049	0,683	2,732	3,415								
47µF tan 1ohm		1	1	2		2,96	2,96	5,92								
Resistors																
100R	1	1	2	3	0,031	0,031	0,062	0,093								
470R	12		12	12	0,372		0,372	0,372								
1k	5	2	7	9	0,155	0,062	0,217	0,279								
2k2		16	16	32		0,496	0,496	0,992								
7.5k	6		6	6	0,186		0,186	0,186								
8.2k		2	2	4		0,062	0,062	0,124								
9k1	1		1	1	0,031		0,031	0,031								
10k	3	6	9	15	0,093	0,186	0,279	0,465								
15k	1	2	3	5	0,031	0,062	0,093	0,155								
100k		4	4	8		0,124	0,124	0,248								
200k		1	1	2		0,031	0,031	0,062		1	1	2		0,42	0,42	0,84
1M		6	6	12		0,198	0,198	0,396								
Discrete Semiconductors																
1N5818	3		3	3	0,609		0,609	0,609								
BC547		4	4	8		0,36	0,36	0,72								
BC557		4	4	8		0,4	0,4	0,8								
LED 5mm	1		1	1	0,3		0,3	0,3								
Integrated Circuits																
6N139	2		2	2	1,836		1,836	1,836	2		2	2	1,9		1,9	1,9
7805	1		1	1	0,6		0,6	0,6	1		1	1	0,48		0,48	0,48
AT90S4433P	1		1	1	6,62		6,62	6,62	1		1	1	6,62		6,62	6,62
INA114AP		2	2	4		16,04	16,04	32,08		2	2	4		13,64	13,64	27,28
MAX232	1		1	1	3,68		3,68	3,68	1		1	1	2,2		2,2	2,2
TL431CLP	1		1	1	0,427		0,427	0,427	1		1	1	0,56		0,56	0,56
TLC277P		4	4	7		6,68	6,68	11,69		4	4	7		6,2	6,2	10,85
TMV0505S	1		1	1	11,3		11,3	11,3								
Miscellaneous Parts																
20k		3	3	6		8,67	8,67	17,34		3	3	6		4,71	4,71	9,42
22µH	3		3	3	0,6		0,6	0,6	3		3	3	3,99		3,99	3,99
7.3728MHz	1		1	1	0,546		0,546	0,546	1		1	1	0,64		0,64	0,64
PINHD-2X17	1	1	2	3	2,87	2,87	5,74	8,61	1	1	2	3	2,46	2,46	4,92	7,38
PINHD-2X5	1		1	1	2,14		2,14	2,14	1		1	1	0,78		0,78	0,78
Sockets																
8-pin socket	2	6	8	14	0,12	0,36	0,48	0,84								
16-pin socket	1		1	1	0,121		0,121	0,121								
28-pin socket	1		1	1	0,16		0,276	0,276								
Socket strip																

Notes

Crystal and loading capacitors (Cxtal)
The crystal's loading capacitors must be chosen appropriately. Set Cxtal = (Cload - Cstray) * 2
Cload (crystal loading capacitance) is given in the crystal data sheet. Cstray is stray capacitance on the PCB + microcontroller. Estimate Cstray = 3 - 5pF.

47uF 1 ohm capacitor
This capacitor is hard to locate in through-hole form (unless you order from Newark) You can replace it with an SMD type.
Mount an SMD like this: Solder the negative end to its pad. Have the positive end land on the ground plane. Scrape off the solder mask
in front of the positive end and solder.
Also note that any ESR = 0.8 ohm to 1.2 ohm is acceptable.

Microcontroller
The AT90S4433 is "not recommended for new designs" which is industry-speak for "we are not going to manufacture this part for much longer".
The replacement is the ATmega8. However, it has a problem associated with it:
ADC channels 5 and 6 are only 8 bit, while the EEG board is designed with 10 bit resolution in mind. (Channels 1 - 4 are ok though.)

TLC277 amplifier
In a four channel EEG setup (two amplifier boards), you only mount IC201 on **one** board.

DCDC converter
TMV0505S is not available in many places. It can be replaced with NMV0505SA. This converter has a rather high output voltage (6-7 V) at very light loads.
Therefore, when building the digital board, mount all parts except the microcontroller. Turn on the power and measure the voltage in the +5V/3 net, e.g. at IC103 pin 8.
The voltage should be LESS than 6V. If not, you must reduce the value of R127 (near the LED), in order to present the DCDC converter with a higher load.

Pin headers
These are fairly expensive at RS (order code 531-942, you need 17x2 + 17x2 + 3x2 = 74 pins total) so try to find them elsewhere.
You need 2.54mm pitch double-row headers or equialent connectors, for ribbon cable. The ribbon cable can be made from an old floppy-drive cable.

Socket strip
Instead of soldering wires directly to the PCB's you can solder in socket strips which you have cut into suitable lengths.
Then insert the wires into the sockets without soldering, during the testing phase. This way you do not risk breaking the wires before putting everything securely in a box.
(Then you should solder them in.) 0.5mm diameter single-strand wire is suitable.

Reichelt notes

1) Crystal loading capacitance is 32pF so Cxtal = 56pF (estimate Cstray = 4pF)
2) Higher grade is available: INA114BP which costs €13.60. Note that for this application this is hardly needed.
3) The MAX232 listed does not have ESD protected I/O pins. Protected type has part no MAX232 ECPE and costs€4.80.
4) Two 14-pin sockets

RS components notes

Prices were calculated from SEK to Euros by dividing by ten but at the time of writing 1 EUR = 9 SEK. Also, VAT is not included.

1) Crystal loading capacitance is 7pF so Cxtal = 10pF (estimate Cstray = 5 pF)
2) Avoid buying these parts from here. They are more expensive than they need to be.
3) TMV0505S is replaced by NMV0505SA

Newark Electronics notes

1) Crystal loading capacitance is 20pF so Cxtal = 33pF (estimate Cstray = 4pF)
2) The part has 2.5mm lead pitch - bend to 5mm
3) The part has 5mm lead pitch rather than 10mm. C220 can be mounted two ways. The lower placement (seen PCB layout) is the correct one.
4) This part may be replaced with a small aluminium electroytic. Part no 18C4465 for $0.063
5) **Digital board capacitors** can be replaced by an aluminium electrolytics. This may degrade noise immunity. (Probably not). Part no 18C4469 for $0.147
6) ESR=1.2 Ohm. Can be replaced with an ESR=1.0 Ohm type. Part no 87F5155 for $4.78
7)
8)
9) Higher grade INA114BP is available. Part no 35C1716 for $12.08
10) A cheaper alternative is MAX232 CPE that lacks ESD protection. Part no 34C3833 for $2.91
11) TMV0505S is replaced by NMV0505SA

Digi-Key notes

1) Carbon resistor for possibly improved ESR protection
2) Can be replaced with the newer generation ATMEGA8-16PI-ND $6.33 see **Microcontroller** note above.
3) Higher grade: INA114BP-ND $10.28
4) Or S2212-17-ND tin $1.77 - a special order item