

CONNECT SYSTEMS INCORPORATED

1802 Eastman Ave., Suite 116
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FLEX SERIES UNIVERSAL CONTROLLER

Hardware Reference Manual

Made in U.S.A.

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TABLE OF CONTENTS

TEN POSITION SCREW TYPE OF TERMINAL BLOCK	4
FRONT PANEL DB9 CONNECTOR (FEMALE)	6
BACK PANEL DB9 CONNECTOR (MALE)	6
BACK PANEL PROGRAMMING JACK	7
BACK PANEL TELEPHONE JACK	7
ADJUSTMENTS	8
JUMPER STRAP OPTIONS	10
GENERAL CIRCUIT DESCRIPTION	12
REVISION HISTORY	15
PARTS LIST	16
SCHEMATICS	23

TEN POSITION SCREW TYPE OF TERMINAL BLOCK

RX AUDIO For the products detecting CTCSS, DCS, or LTR, or products that use the internal squelch, the RX AUDIO must be connected to the discriminator of the radio. For all other products the RX AUDIO can be connected to the discriminator, high side of the volume control, or the speaker.

TX AUDIO For products that generate CTCSS, DCS, or LTR, the TX AUDIO must be connected directly to the modulator of the transmitter. For LTR and DCS, the modulator must be true FM. For CTCSS the modulator can be phase modulated or FM modulated. For all other applications, connections to the high side of the microphone is acceptable.

It should be noted that in most communication controllers there is a separate line for voice audio and a separate line for the CTCSS, DCS, or LTR signals. This is because to combine the two the controller has to have a limiter on the voice line to prevent over modulation and other undesirable side effects. The Flex Series Controllers has a built in limiter thereby not requiring separate lines.

PTT The PTT normally hooks to the PTT of the transmitter. If you are using a Hand Held with the PTT sharing a common connection with the transmit audio, then attach a resistor with a value between 2.4K and 4.7K from the PTT to the TX Audio and attach the TX audio line to the center conductor of the microphone cable. In most product that use the PTT, the AUX relay can also be used as a PTT connection. This has the advantage of allowing positive keying or other situations where the normal open collector PTT does not work.

COS Connect to a point that has a good voltage swing when the squelch is opened/closed. The best point to connect is to the collector of the transistor that controls the busy light (if the receiver has one). Otherwise you may connect to the squelch control voltage. The minimum voltage for the COS is about 0 volts and the Maximum voltage is the supply voltage.

Some radios have that point coming out the back of the radio. It sometimes goes under the name of squelch detect, sq det, or COR. In some case a pull up or pull down resistor is necessary.

The polarity and other parameters associated with the COS is contained within the programming parameters

described later. It should be noted that in most cases, the COS can be replaced with the internal squelch.

SENSE This point is used as an auxiliary input for specialized purposes in certain products. As an example, this input may be used to detect the presence of a CTCSS/DCS signal in an LTR system. The minimum voltage for the sense input is about 0 volts and the Maximum voltage is the supply voltage.

The polarity and other parameters associated with the SENSE is contained within the programming parameters if used.

AUX RELAY These two points connects to the center contact and normally open contact of the relay. The use if any depends upon the product.

+12 VDC Connect to a source of 12 volts to 15 volts DC. The Flex Series Controllers are reverse polarity protected, so a polarity mistake will not damage the product. Connect the return lead to ground.

GND The two grounds in the system are internally connected to each other.

FRONT PANEL DB9 CONNECTOR (Female)

This connector is used for programming the system using a lap top computer or a desk top computer or as a serial output port for certain products such as the Communication decoder.

Programming will be via a Microsoft windows based program that will be available at no charge sometime next year.

Pin 1: -6 volts
Pin 2: transmit (data from flex to P.C.)
Pin 3: receive (data from P.C. to flex)
Pin 4: not used
Pin 5: ground
Pin 6: -6 volts
Pin 7: not used
Pin 8: -6 volts
Pin 9: not used

BACK PANEL DB9 CONNECTOR (Male)

This connector is used for programming the system via an external modem.

Programming will be via a Microsoft windows based program that will be available at no charge sometime next year.

Pin 1: not used
Pin 2: receive (data from P.C. to flex)
Pin 3: transmit (data from flex to P.C.)
Pin 4: -6 volts
Pin 5: ground
Pin 6: not used
Pin 7: not used
Pin 8: not used
Pin 9: not used

BACK PANEL PROGRAMMING JACK

This jack serves three purposes:

1. By plugging a telephone in the back, the user can program the various parameters as allowed by the system by means of the 12 position keypad on the telephone.
2. The mouth piece of the telephone can be used for storing voice prompts in the system.
3. Can be used for communications with other Flex Series Controllers via a RS485 Interface.

Pin 1: not used
Pin 2: RS485 Connection
Pin 3: Tip for telephone
Pin 4: Ring for telephone
Pin 5: RS485 Connection
Pin 6: not used

BACK PANEL TELEPHONE JACK

This jack connect to the telephone line and is used for the following purposes:

1. Remote programming via a telephone
2. Telephone to radio and radio to telephone connection as in a phone patch
3. Input device for a paging terminal to allow the remote telephone to initiate a page.

Pin 1: not used
Pin 2: not used
Pin 3: Tip for telephone
Pin 4: Ring for telephone
Pin 5: not used
Pin 6: not used

ADJUSTMENTS

P1 HYB BAL

The Hybrid Balance control is used to null out the mobile return audio in full duplex mode. The alignment must take place on one of the phone lines the Flex Series controller will be serving. (This alignment can not be done at the shop prior to delivery to the site.)

Have a mobile place a call through the Flex Series Controller. The party answering the called phone should leave the phone off hook during the alignment procedure.

Monitor the transmitter output with a service monitor or connect an oscilloscope to the "TX OUTPUT" terminal on the rear of the Flex Series Controller. Place all four Dip switches in the off position.

Have the mobile simultaneously press digits 3 and 6 on his touch tone keypad. This will result in the transmission of a single 1477 Hz tone.

Adjust the "HYB BAL" Potentiometer to produce the least audio output. Try all possible dip position combinations and null each time. The combination which gives the minimum output is the correct position to use.

Changes made within the telephone company or rerouting of telephone lines could occasionally require re-adjustment of the hybrid.

P3 TEL VOX

Used for detection of call progress tones and sensitivity to voice in Vox operated applications. Turning the pot clockwise increases its sensitivity.

P4 PREAMP

The preamp control is used to match the audio level from your receiver to the Flex Series controller. To adjust, a signal containing 100 Hz CTCSS with about 600 Hz deviation should be applied to the receiver. Adjust the preamp control until a level of 3 volts peak to peak is observed at test point 6. If an oscilloscope is not available, read 1 volt RMS using a VOM.

P5 RX VOX

Used in VOX mode only. Sets RX audio triggering sensitivity. Should be fully clockwise in VOX simplex applications. Reduce setting when used through repeaters if land line cannot respond to

mobile during hang time due to noise or tone on the repeater carrier.

P6 AUDIO OUT Adjust the maximum level going to the transmitter. When turned fully clockwise, an output voltage of about five volts peak to peak is obtained. In most case the output level can also be set in the programming mode.

P7 CONTRAST Sets the contrast of the LCD. Adjust to what is most pleasing to the individual.

P8 SQUELCH Advance clockwise to a point just beyond where the front panel display "Rx" message disappears. Not all products will display the Rx message.

JUMPER STRAP OPTIONS

- JP1** **Line In Use Detector.** When inserted, enables line in use detection. That allows the system to detect if another phone in parallel with the controller is off hook. Will only work with a phone system where the nominal on hook voltage is about 48 volts.
- JP2,JP18** **Preamp Gain.** With jumper 18 not installed and Jumper 2 not installed, gain is 100 with flat audio.
- With jumper 18 not installed and Jumper 2 in "A" position, gain is 10 with flat audio.
- With Jumper 18 not installed and Jumper 2 in "B" position, gain is 10 with a 3 db roll off starting at 300 Hz.
- With jumper 18 installed and Jumper 2 not installed, gain is 100 with 3 db roll off starting at 300 Hz.
- With jumper 18 installed and jumper 2 in "A" position, has a gain of 10 with 3 db roll off starting at 3 KHz.
- With jumper 18 installed and jumper 2 in "B" position, has a gain of 10 with a 3 db roll off starting at 300 Hz.
- JP3** Product Specific. See product manual
- JP4** Product Specific. See product manual
- JP5** Product Specific. See product manual
- JP6** Product Specific. See product manual
- JP7** Product Specific. See product manual
- JP8** Product Specific. See product manual
- JP9** Product Specific. See product manual
- JP10** Product Specific. See product manual
- JP11** Selects the radio audio source to be either pre-emphasized or flat
- JP12,JP13** RS232 Source. Determines if the source of the RS232 port is from the internal UART of the microprocessor or from two general I/O pins. Used for future products.
- JP14** When connected, this allows a secondary D/A converter to be connected to pin 9 of the 10 position screw type of terminal block. When used in this mode, the aux relay cannot be used.

- JP15** The terminating resistor when used for RS485 communication. Only use one per system.
- JP16** When inserted, allows the TX Audio output to be DC coupled.
- JP17** Connects pin 6 of 10 position screw type of terminal block to the internal circuitry of the system. Should normally be connected. Only used for testing purposes.
- JP18** See JP2
- JP19** Selects the audio source for the voice recorder to be either from the telephone/programming jack or the radio
- JP20** Selects the telephone audio source to be either pre-emphasized or flat

GENERAL CIRCUIT DESCRIPTION

Telephone Interface

Telephone call comes in Telco Jack J1. If the voltage exceeds about 250 volts, the two varistors, V1 and V2 will conduct and blow the two fuses F1 and F2. This protects against lightning and other high voltage transients on the telephone line.

If the systems gets a ringing voltage, the optoisolator Q1 will conduct and the output RD1 will present a square wave at the microprocessor whose frequency is the same as the incoming ringing frequency. The microprocessor will determine if it's a valid ringing signal. The optoisolator Q2 determines if the voltage on the telephone is about 48 volts. If it is the signal LBI will be grounded. If the voltage goes below about 48 volts that point will be high.

When the telephone line is connected and the line relay is pulled in, then the two optoisolators Q3 and Q4 will indicate the presence of loop current and the direction of the current. This circuit allows the system to determine if the phone line has been hung up by a momentary loss of loop current or a reversal of the loop current.

The hybrid transformers T1 and T2 along with the balancing network allows the system to separate the receive and transmit audio. This is only necessary in a full duplex phone patch.

Receive Telephone Audio

The output of T1 is presented to U1D where the Op-Amp provides an anti-aliasing filter to the Voice storage chip U17 and the DTMF decoder U3. The receive telephone audio passes to the Analog to Digital Converter on the microprocessor as the signal AD_TELCO and to the circuitry surrounding U1A where the function of Telephone Vox is implemented. U18-C will pre-emphasize the telephone audio if the audio out is going to directly feed the modulator of the transmitter.

Transmit Telephone Audio

The output of the Digital to Analog Converter from the microprocessor (DA_TELCO) is passed to U19 which forms a five pole low pass filter. This circuitry is needed properly reconstruct the data coming from the microprocessor. U1B provides gain before being outputted to the telephone line.

Voice Storage Chip

The voice storage chip is used to store up to two minutes of voice from either the telephone, programming port, or the radio.

The connection from the radio to the voice storage chip is not always direct (dependent on Jumper 19). To accomplish this task, the unit digitizes the voice from the radio and then outputs it to the telephone. If the telephone line relay is not pulled in or the system is not connected to the telephone line, then the hybrid is not balanced and the audio to the telephone output will be reflected back to the telephone audio input where it then has a clear path to the voice storage chip.

Telephone DTMF Decoder

The audio from the telephone is decoded by the DTMF decoder U3. When pin 15 on the DTMF decoder chip is high, it signals to the microprocessor pin that data is waiting where it is then read.

Radio Receive Audio

U5A provides a low pass filter used to get rid of high frequency garbage from the radio. U5B provides the de-emphasis network. The audio from U5B goes to the RX-VOX, DTMF decoder, zero crossing detector, and the 6 pole high pass filter consisting of U10A, U10B, and U10D. The output of the filter is used to remove sub audible CTCSS, DCS, or LTR tones from the radio before being presented to the microprocessors A/D converter.

U5-D will pre-emphasize the radio audio if the receive out is going to directly feed the modulator of the transmitter.

The receive audio also goes to U13A-U13D, U18A and U18B which is a squelch detector. The squelch detector is used to determine the presence of squelch noise from the radio receiver.

Radio Transmit Audio

The output of the microprocessors D/A converter is reconstructed by U20, a five pole low pass filter. U4C is used to get rid of any high frequency clock noise from the audio and U4D is used to amplify the results before being presented as transmit audio.

Squelch Detector

U13A and U13B act as a four pole high pass filter to remove any low frequency signals below about 11KHz. U13 act as a gain stage where it is then detected by U13D. R110 and C92 act as a smoothing filter where it is then presented to the microprocessor via U18B

Zero Crossing Detector

U6D and U6C act as a four pole low pass filter designed to pass only the CTCSS, DCS or LTR subaudible signals. U6A and U6B along

with the transistors act as a zero crossing detector where it is then presented as a digital signal to the microprocessor.

COS Detector

U4B acts as a buffer between the outside world and the A/D converter on the microprocessor. The logic within the microprocessor determines if the COS should be derived from the COS detector or the Squelch detector.

Push To Talk

Transistor Q9 acts as a buffer between the microprocessor and the outside world. D14 is used to protect the circuit against any transients.

Sense Detector

U4A acts as a buffer between the outside world and the A/D converter on the microprocessor. The logic within the microprocessor determines the function of that signal.

EEPROM

The EEPROM is used for parameter storage and occasionally certain real time data. The part is read and written to by the IIC port on the microprocessor.

Computer Interface

U12 converts the RS232 levels to levels compatible with the UART internal to the microprocessor or the port pins, dependent on how JP12 and JP13 are jumpered.

External Network

U16 converts the levels from the second UART built into the microprocessor to the appropriate levels compatible with RS485 communications. This can be used to tie multiple flex series controller together.

LCD Interface

The microprocessor talks to the LCD controller via a four bit interface.

Aux Relay

The microprocessor can turn on and off the auxiliary relay by means of a control pin attached to R93.

JTAG Interface

The microprocessor can be reprogrammed via a JTAG interface. This allows the user to change the characteristic of the controller by means of software available on our web site.

Power Supply

The power supply generates 5 volts, and 3.3 volts from a 12 volt or greater power source.

REVISION HISTORY

July 6, 2003 First Release

CONNECT SYSTEMS INC. 1802 EASTMAN AVE #116 VENTURA, CA. 93003	PARTS LIST PCBA, MODEL 9900	REV F
SHEET 1 OF 7		

DRAWN BY J. WANGER	APPROVED	DATE APPROVED
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ITEM	QTY		DESCRIPTION	REF DESIGNATION
	UNIT	ISSUED		
1	1		P.C.B., MODEL 9900	MODEL 9900
3	4		CAP, SMD 0805, 33 pF 08055A330JAT2A	C43,C50,C60,C61
2	1		CAP, SMD 0805, 82 pF 08055A820JAT2A	C102
4	5		CAP, SMD 0805, 120 pF 08055A121JAT2A	C9,C25,C30,C99,
5				C104
6	1		CAP, SMD 0805, 270 pF 08055A271JAT2A	C13
7				
8	5		CAP, SMD 0805, .001 uF 08055C102JAT2A	C54,C70,C71,C72,
9				C73
10	5		CAP, SMD 0805, .0022 uF 08055C222JAT2A	C10,C87,C88,C89,
11				C90
12	2		CAP, SMD 0805, .0047 uF 08055C472JAT2A	C28,C38
13	10		CAP, SMD 0805, .01 uF 08055C103JAT2A	C6,C24,C40,C44,
14				C45,C46,C47,C48,
15				C49,C91
16				
17	1		CAP, SMD 0805, .015 uF 08055C153JAT2A	C39
18	1		CAP, SMD 0805, .022 uF 08055C223JAT2A	C7
19	3		CAP, SMD 0805, .047 uF 08055C473JAT2A	C11,C27,C37
20				
21				
22				
23				
24				

CONNECT SYSTEMS INC. 1802 EASTMAN AVE #116 VENTURA, CA. 93003	PARTS LIST PCBA, MODEL 9900	REV F
SHEET 2 OF 7		

DRAWN BY J. WANGER	APPROVED	DATE APPROVED
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ITEM	QTY		DESCRIPTION	REF DESIGNATION
	UNIT	ISSUED		
25	45		CAP, SMD 0805, .1 uF 08055C104KAT2A	C1,C4,C12,C16,
26				C17,C19,C20,C21,
27				C22,C23,C32,C33,
28				C34,C36,C41,C42,
29				C55,C56,C57,C59,
30				C62,C63,C64,C65,
31				C66,C67,C68,C74,
32				C75,C76,C77,C78,
33				C79,C81,C84,C86,
34				C93,C96,C97,C98,
35				C100,C101,C107,
36				C115,C116
37	1		CAP, SMD 0805, .22 uF 08053C224KAT2A	C29
38	1		CAP, .47 uF, 250V, EF2474-NO	C3
39	6		CAP, 1 uF, 50V, ELECT, 50TWSS1	C5,C14,C15,C18,
40				C31,C92
41				
42	2		CAP, 2.2 uF, 50V, ELECT, 50TWSS2R2	C94,C95
43	3		CAP, 4.7 uF, 50V, ELECT, 50TWSS4R7	C26,C51,C58
44	1		CAP, 10 uF, 50V, ELECT, 50TWSS10	C8
45	4		CAP, 33 uF, 25V, ELECT, 25TWSS33	C2,C82,C83,C85
46				
47				
48	2		CAP, 47 uF, 35V, ELECT, 35TWSS47	C35,C103

CONNECT SYSTEMS INC. 1802 EASTMAN AVE #116 VENTURA, CA. 93003	PARTS LIST PCBA, MODEL 9900	REV F
SHEET 3 OF 7		

DRAWN BY J. WANGER	APPROVED	DATE APPROVED
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ITEM	QTY		DESCRIPTION	REF DESIGNATION
	UNIT	ISSUED		
49	5		CAP, 220 uF, 35V, ELECT, 35TWSS220	C52,C53,C80,
50				C105,C106
51	2		CONNECTOR, RJ11, 6 POS, 66011-002	J1-J2
52	1		CONNECTOR, 10 POS BARR BLK 70810C	J3
53	1		CONNECTOR, 8P HDR, LONG PIN, 22-03-2082	J4
54	1		CONNECTOR, DB9P, RT ANG, DE9P318,104942	J6
55	1		CONNECTOR, DP9S, RT ANG, DE9S318,104951	J5
56	1		CONNECTOR, 2 x 5,FAN-10SGS	J8
57	2		HEADER, 2 x 4 PIN TDB-08SGS	JP3-JP10
58	1		HEADER, 14 PIN, 2X7, 10-88-1141	LCD
59	6		CONNECTOR, 2 PIN HEADER, TD-2SG	JP1,JP14,JP15,
60				JP16,JP17,JP18
61	6		CONNECTOR, 3 PIN HEADER, TD-3SG	JP2,JP11,JP12,
62				JP13,JP19,JP20
63	20		CONNECTOR, SHORTING BLOCK, DM-2GM-0	JP1-JP20
64	3		DIODE, 1N5245B,ZENER, 15V, CMBZ5245B	D1,D2,D14
65	3		DIODE, 1N4004	D3,D16,D17
66	10		DIODE, 1N4148, MMBD4148	D4,D5,D6,D7,D8,
67				D9,D10,D11,D18,
68				D19
69				
70	1		LED ASSY, RED, LL64233R, LTL-523-11	D15
71	1		LED, RED, SMALL, 35BL504	D12
72				

CONNECT SYSTEMS INC. 1802 EASTMAN AVE #116 VENTURA, CA. 93003	PARTS LIST PCBA, MODEL 9900	REV F
SHEET 4 OF 7		

DRAWN BY J. WANGER	APPROVED	DATE APPROVED
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ITEM	QTY		DESCRIPTION	REF DESIGNATION
	UNIT	ISSUED		
73	2		FUSE, 255.250	F1,F2
74	1		FUSE, 2 AMP, 473.002	F3
75	2		I.C. H11AA4.S, OPTOISOLATOR	Q1,Q2
76	2		I.C. 4N25.S-M, OPTOISOLATOR	Q3,Q4
77	7		I.C. LF347M, QUAD OP AMP	U1,U4,U5,U6,U10,
78				U13,U18
79	1		I.C. LM324M, QUAD OP AMP	U11
80	2		I.C. M-88L70-01S, DTMF DECODER	U3,U7
81	1		I.C. uA78M33CKC, 3.3 V REGULATOR	U8
82	1		I.C. LM78L05ACM, 5.0 V REGULATOR	U9
83	1		I.C. MAX5380LEUX, D/A CONVERTER	U2
84				
85	1		I.C. MAX3221CAE, RS232 INTERFACE	U12
86	1		I.C. 24LC256I/SN, 256K IIC EEPROM	U14
87	1		I.C. C8051F124, MICROPROCESSOR	U15
88	1		I.C. SP3485CN, RS485 TRANCEIVER	U16
89				
90	1		I.C. ISD4002-120S, VOICE RECORDER	U17
91	2		I.C. MAX7413CUA, 5th ORDER BESSEL FLTR	U19,U20
92				
93	1		POT, 2K, 3386P-1-202	P1
94	5		POT, 10K, 3386P-1-103	P3,P4,P5,P6,P7
95	1		POT, 100K, 3386P-1-104	P8
96				

DRAWN BY J. WANGER	APPROVED	DATE APPROVED
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ITEM	QTY		DESCRIPTION	REF DESIGNATION
	UNIT	ISSUED		
97	2		RELAY, G5V-2-DC12	RLY1,RLY2
98				
99	1		RESISTOR, 1/2 W, 100, CARBON FILM	R13
100	3		RESISTOR, 1/2 W, 220, CARBON FILM	R9,R12,R14
101	1		RESISTOR, 1/2 W, 1K, CARBON FILM	R4
102	1		RESISTOR, 1/2 W, 22K, CARBON FILM	R3
103	1		RESISTOR, 1/2 W, 33K, CARBON FILM	R6
104	2		RESISTOR, 1/4 W, 620, CARBON FILM	R16,R20
105	1		RESISTOR, SMD 0805, 0	R1
106	1		RESISTOR, SMD 0805, 100	R21
107	1		RESISTOR, SMD 0805, 240	R19
108	1		RESISTOR, SMD 0805, 470	R52
109	1		RESISTOR, SMD 0805, 620	R83
110	11		RESISTOR, SMD 0805, 1K	R26,R39,R59,R73,
111				R78,R82,R84,R90,
112				R96,R115,R136
113	2		RESISTOR, SMD 0805, 1.1K	R32,R64
114	1		RESISTOR, SMD 0805, 2K	R114
115	11		RESISTOR, SMD 0805, 2.2K	R17,R27,R44,R62
116				R85,R86,R87,R97,
117				R107,R110,R127
118	1		RESISTOR, SMD 0805, 3.3K	R104
119	2		RESISTOR, SMD 0805, 4.7K	R43,R103
120				

CONNECT SYSTEMS INC. 1802 EASTMAN AVE #116 VENTURA, CA. 93003	PARTS LIST PCBA, MODEL 9900	REV F
SHEET 6 OF 7		

DRAWN BY J. WANGER	APPROVED	DATE APPROVED
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ITEM	QTY		DESCRIPTION	REF DESIGNATION
	UNIT	ISSUED		
121	15		RESISTOR, SMD 0805, 5.1K	R10,R25,R58,R72,
122				R81,R91,R94,R98,
123				R108,R109,R113,
124				R119,R133,R134,
125				R135
126	2		RESISTOR, SMD 0805, 8.2K	R63,R106
127	2		RESISTOR, SMD 0805, 10K	R38,R41
128	1		RESISTOR, SMD 0805, 12K	R70
129	1		RESISTOR, SMD 0805, 13K	R105
130	2		RESISTOR, SMD 0805, 15K	R30,R47
131	2		RESISTOR, SMD 0805, 18K	R29,R46
132	3		RESISTOR, SMD 0805, 22K	R22,R31,R95
133	2		RESISTOR, SMD 0805, 27K	R18,R116
134	16		RESISTOR, SMD 0805, 33K	R2,R8,R65,R68,
135				R79,R80,R88,R89,
136				R92,R93,R99,
137				R100,R101,R102,
138				R112,R126
139	3		RESISTOR, SMD 0805, 47K	R66,R67,R76
140	2		RESISTOR, SMD 0805, 51K	R53,R54
141	3		RESISTOR, SMD 0805, 62K	R55,R56,R69
142	1		RESISTOR, SMD 0805, 75K	R51
143				
144				

CONNECT SYSTEMS INC. 1802 EASTMAN AVE #116 VENTURA, CA. 93003	PARTS LIST PCBA, MODEL 9900	REV F
SHEET 7 OF 7		

DRAWN BY J. WANGER	APPROVED	DATE APPROVED
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ITEM	QTY		DESCRIPTION	REF DESIGNATION
	UNIT	ISSUED		
142	12		RESISTOR, SMD 0805, 100K	R24,R34,R35,R37,
143				R40,R42,R48,R50,
144				R57,R61,R111,
145				R117
146	1		RESISTOR, SMD 0805, 150K	R36
147	1		RESISTOR, SMD 0805, 180K	R71
148	2		RESISTOR, SMD 0805, 220K	R60,R77
149	5		RESISTOR, SMD 0805, 300K	R23,R33,R49,R74,
150				R118
151	2		RESISTOR, SMD 0805, 470K	R28,R75
152	4		RESISTOR, SMD 0805, 1M	R5,R7,R11,R15
153	1		RESISTOR, SMD 0805, 1.5M	R45
154	1		SWITCH, 4 POSITION DIP, CTS-206-4	S1
155	2		TRANSFORMER, 671-1898	T1,T2
156	3		TRANSISTOR, MMBT2907A/MMBT2907A-LT1	Q5,Q7,Q12
157	3		TRANSISTOR, MMBTA13/MMBTA13-LT1	Q6,Q10,Q14,Q15
158	3		TRANSISTOR, MMBT2222A/PMBT2222A	Q8,Q9,Q11
159				
160	2		VARISTOR, V250LA20, MOV, 250V	V1,V2
161				
162	1		XTAL, 3.58 MHz, KD0048FCB	Y1
163	1		XTAL, 22.1184 MHz, FOX 221	Y2
164	1		HEAT SINK	U8
165	1		LABOR, ASSEMBLY, 9900 PCB	















