MAINTENANCE MANUAL
SYNTHESIZER BOARD
19C851880G1 136-153 MHz
19C851880G2 150-174 MHz

TABLE OF CONTENTS

DESCRIPTION

The synthesizer board 19C851880G1 & G2 (136-174 MHz) generates all transmit and receive RF frequencies for MPI-II Personal radio. The frequency synthesizer circuit generates the transmit carrier frequency and the first mixer injection frequency for the receive circuit. This circuit uses a phase-locked Voltage Controlled Oscillator (VCO) operating on the actual transmitter frequency (136-153 MHz for 19C851880G1 150-174 MHz for 19C851880G2) during transmit and 45 MHz above the actual receive frequency during receive. The Synthesizer Board plugs into the Transmit/Receive Board at P5 and P6. See Figure 1 for the Synthesizer Block Diagram.

CIRCUIT ANALYSIS

The synthesizer frequency output is controlled by the microprocessor on the Transmit/Receive Board. Frequency stability is maintained by a temperature compensated crystal controlled reference oscillator (TCXO) module (U203). The oscillator has a stability of ±5 PPM over the temperature range of -30°C to 60°C and determines the overall stability of the radio.

The synthesizer output signal is generated directly at VCO module U204. The output from U204 is fed through a low pass filter to the Prescaler U202, the Local Oscillator buffer and the Power Amplifier buffer. The Local Oscillator and the Power Amplifier are located on the T/R Board. The VCO output is also buffered by the transistor Q201 to feed divide by 64/65 dual modulus prescaler U202. The prescaler feeds the Fin input of the Phase-Lock-Loop (PLL) chip U201.

Within U201, the prescaler signal is further divided down to 5 kHz to be compared with a reference signal. This reference signal is derived from 12.8 MHz TCXO module U203. The PLL chip, U201, divides the 12.8 MHz TCXO down to the 5 kHz reference frequency. Divider circuits in U201 are programmed by three inputs from the microprocessor on the T/R Board. These are SYN ENABLE, SYN DATA and SYN CLOCK lines. A LOCK DETECT line from the PLL chip to the T/R Board microprocessor is used to prevent transmissions when the synthesizer is unlocked. A pulsed beep will be sounded if this condition occurs.

Ericsson GE Mobile Communications Inc.
Mountain View Road • Lynchburg, Virginia 24502

Printed in U.S.A.

LBI-38556

NOTE

The Prescaler will cause low level "tweets" to be heard in the receiver in the frequency range of **160.655-160.755 MHz.** When a frequency in this range is programmed, the PC programmer will display the following message:

> Select Alternate Prescaler (Option F7) for this frequency. Refer to Maintenance Manual LBI-38556.

A modification is needed to change the Prescaler divider ratio to eliminate the "tweet". Remove R232 and place it (or a direct short) in the location for R233. The PC programmer will configure the channel information sent to the radio based on whether or not this change is made.

Audio modulation from the T.R Board is applied to the Synthesizer Board at P6-2. Audio Modulation then goes to Mod Pot R230 to adjust the modulation level. The output from the Mod Pot is summed with the unfiltered control voltage and fed to operational amplifier U206.2. Amplifier U206.2 is biased to produce gain variation with different control voltages. When the control voltage is below 1.7 volts, both diodes in diode package D201 are biased off. The op amp gain is then unity. As the control voltage rises above approximately 1.7 volts, one of the diodes (D201) is forward biased. This increases the op amp gain to approximately 1.2. Further increases in the control voltage above approximately 2.5 volts turns both diode paths on, thus increasing gain to about 1.4. Gain variation versus control voltage compensates for decreasing VCO gain at higher control voltages. The net affect of this is to linearize the loop response across the frequency band to maintain relatively constant audio modulation and constant digital Channel Guard waveshape.

The synthesizer enable line also drives bilateral switches U205.2 and U205.3. The pulse applied to these gates, when channel changes occur, turns the gates on which shorts out resistors R224 and R225. This allows rapid channel acquisition.

During Standby operation, the Synthesizer 5.4 volts is switched ON for 25 ms and OFF for 75 ms. In order to facilitate channel acquisition during Standby operation, bilateral switch U205.1 is driven by the Synthesizer data line to quickly determine if a carrier with the proper signalling tone is present. If no carrier or a carrier with incorrect tone is detected, the radio remains in Standby. If a carrier with the proper tone is detected, the Synthesizer 5.4 volts is switched ON continuously until the carrier and/or the tone is removed.

A delay and isolation circuit is applied to the output of the VCO to prevent unwanted Synthesizer output before the VCO has locked and settled on frequency. This is necessary to prevent excessive L.O. leakage at the antenna terminal. Components of this circuit are R239-R247, C231-C233, Q203, Q204 and D202. When the Synthesizer 5.4V is applied in receive mode, D202 is reversed biased to maximize isolation. "Enable" pulse is applied to Q204 and Q205, delayed by five milliseconds (set by R239, R240, C231), whereupon the transistor pair "latches up" and forward biases D202, connecting the VCO output to the "Synthesizer Output" pin (P5-P6).

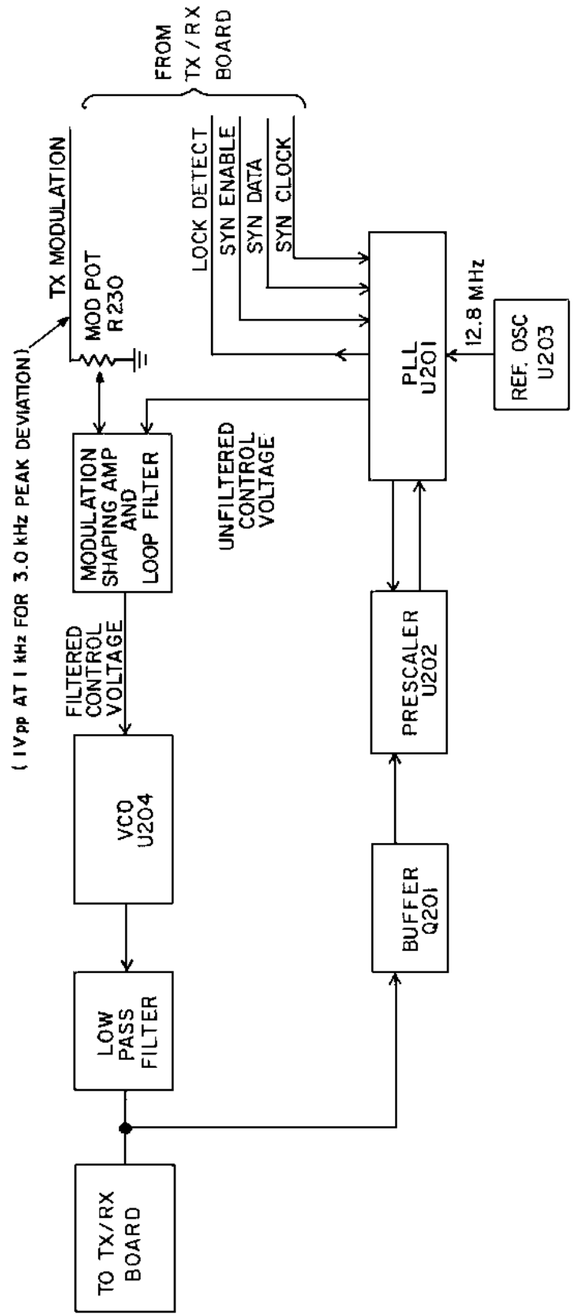
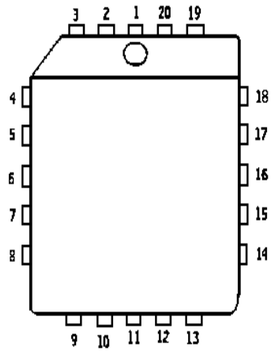
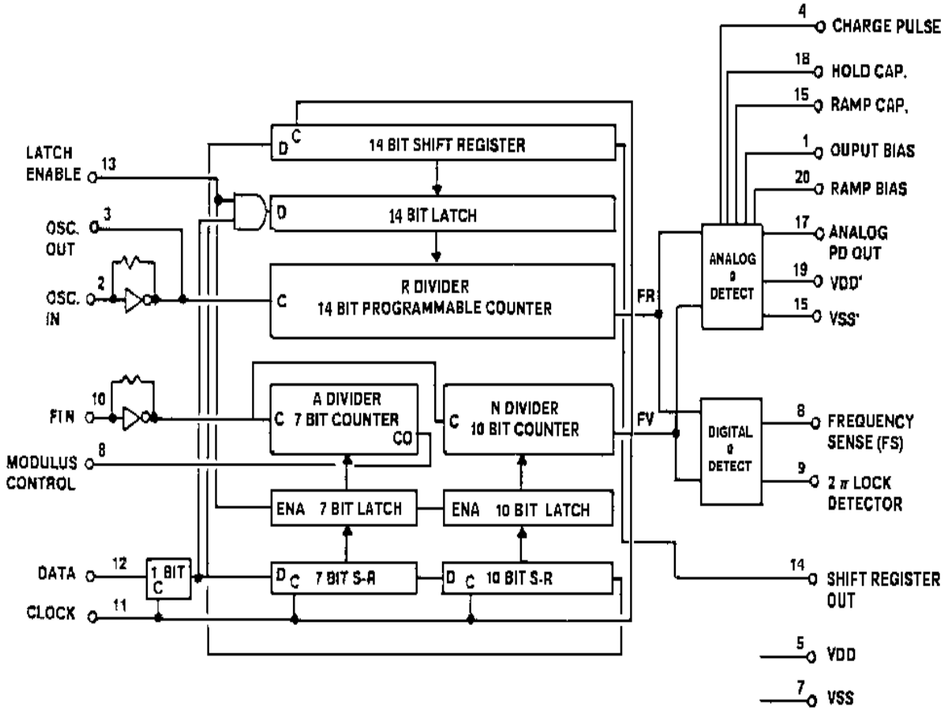


Figure 1 - Synthesizer Block Diagram

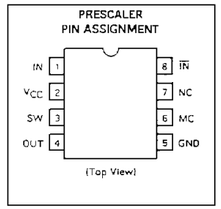
SYNTHESIZER BOARD

U201
SYNTHESIZER
19B800902P5





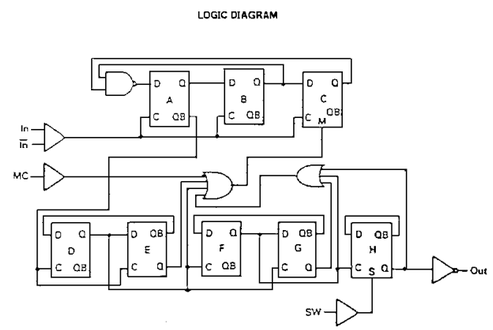
U202
PRESCALER
19A149944P201



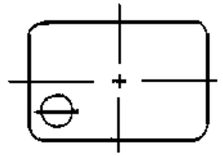
FUNCTION TABLE		
SW	MC	DIVIDE RATIO
H	H	64
H	L	65
L	H	128
L	L	129

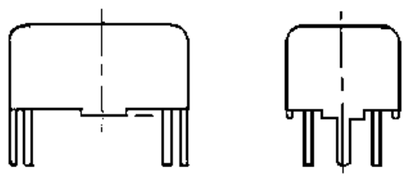
SW: H= Vcc L = OPEN
MC: H= 2.0 V TO Vcc
L= GND TO 0.8V

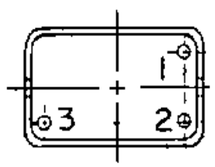
LOGIC DIAGRAM



U203
CRYSTAL OSCILLATOR
19B80135P7,P8,P13



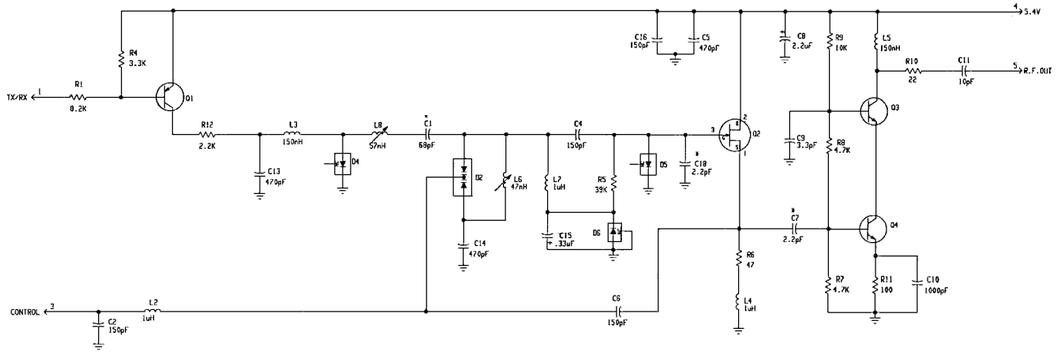




PIN CONNECTIONS

1. COMMON AND CASE
2. OUTPUT
3. + Vcc

U204
VCO
19C851913G1,2



ALL RESISTORS ARE 0.1 WATT UNLESS OTHERWISE SPECIFIED AND RESISTORS VALUES ARE IN OHMS UNLESS FOLLOWED BY MULTIPLIER K OR M.
CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER U, N OR P
INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER M OR U

THIS SCHEMATIC DIAGRAM APPLIES TO	
MODEL NO.	REV LETTER
PL19C851913G1	—
PL19C851913G2	A

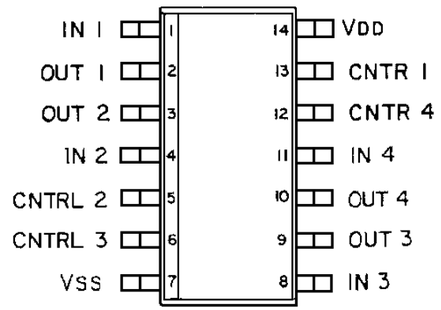
	G1&7	G2&8
	136-153	150-174
C1	33P	68P
C7	3.9P	2.2P
C18	2.2P	—

NOTE: SCHEMATIC DIAGRAM FOR REFERENCE ONLY

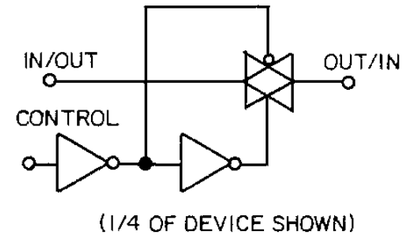
(19D902862, Sh. 1, Rev. 5)

U205
QUAD ANALOG
SWITCH/MULTIPLEXER
19A702705P1,P4
(CMOS)

PIN CONFIGURATION



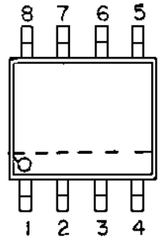
LOGIC DIAGRAM

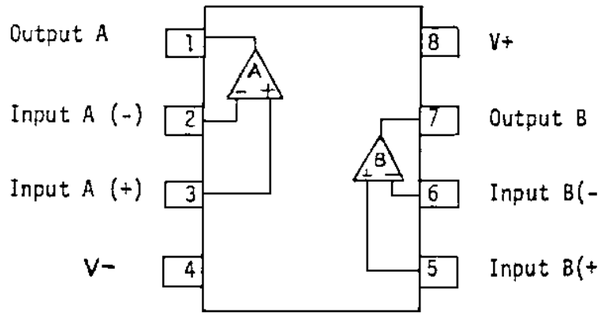


(1/4 OF DEVICE SHOWN)

CONTROL	SWITCH
0	OFF
1	ON

U206
OPERATIONAL AMPLIFIER
19A702293P2 & P3





SYNTHESIZER BOARD

PARTS LIST

SYNTHESIZER BOARD
19C851880G1 136-153 MHz
19C851880G2 150-174 MHz
158VE 3

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C201	19A702061P69	Ceramic: 220 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C202	19A702061P99	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C203 thru C205	19A702061P61	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C206	19A702061P69	Ceramic: 220 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C207	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C208 and C209	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C210	19A702061P61	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C211	19A702061P29	Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C212	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C213	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C214	T644ACF322K	Polyester: .022 uF ±10%, 50 VDCW.
C215	19A700004P10	Metallized Polyester: 1.0 uF ±10%, 63 VDCW.
C216 thru C220	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C221 and C222	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C223	19A705205P5	Tantalum: 6.8 uF, 10 VDCW; sim to Sprague 293D.
C224	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C225 and C226	19A705205P5	Tantalum: 6.8 uF, 10 VDCW; sim to Sprague 293D.
C227	19A700004P9	Metalized polyester: 0.47uF ±10%, 63 VDCW.
C228	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C229	19A702061P45	Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
		- - - - - - - - - - DIODES - - - - - - - - - -
D201	19A703561P2	Silicon, fast recovery (2 diodes in series).
		- - - - - - - - - - PLUGS - - - - - - - - - -
P5 and P6	19A704779P5	Connector, printed wiring, 6 circuits: sim to Molex 22-17-2062.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q201	19A704708P2	Silicon, NPN: sim to NEC 2SC3356.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R201	19B801251P104	Metal film: 100K ohms ±5%, 1/10 w.
R202	19B801251P154	Metal film: 150K ohms ±5%, 1/10 w. (Used in G1).
R202	19B801251P224	Metal film: 220K ohms ±5%, 1/10 w. (Used in G2).
R203	19A702931P249	Metal film: 3160 ohms ±1%, 200 VDCW, 1/8 w. (Used in G1).
R203	19A702931P233	Metal film: 2150 ohms ±1%, 200 VDCW, 1/8 w. (Used in G2).
R204	19B801251P272	Metal film: 2.7K ohms ±5%, 1/10 w.
R205	19B801251P470	Metal film: 47 ohms ±5%, 1/10 w.
R206	19B801751P331	Metal film: 330 ohms ±5%, 1/10 w.
R207 and R208	19B801251P103	Metal film: 10K ohms ±5%, 1/10 w.
R209	19B801251P681	Metal film: 680 ohms ±5%, 1/10 w.
R211	19B801251P473	Metal film: 47K ohms ±5%, 1/10 w.
R212	19B801251P121	Metal film: 120 ohms ±5%, 1/10 w.
R213	19B801251P100	Metal film: 10 ohms ±5%, 1/10 w.
R215	19B801251P101	Metal film: 100 ohms ±5%, 1/10 w.
R216 and R217	19B801251P470	Metal film: 47 ohms ±5%, 1/10 w.
R218	19B801251P683	Metal film: 68K ohms ±5%, 1/10 w.
R219	19A702931P377	Metal film: 61.9K ohms ±1%, 200 VDCW, 1/8 w. (Used in G1).
R219	19A702931P401	Metal film: 100K ohms ±1%, 200 VDCW, 1/8 w. (Used in G2).
R220	19A702931P389	Metal film: 82.5K ohms ±1%, 200 VDCW, 1/8 w. (Used in G2).
R220	19A702931P365	Metal film: 46.4K ohms ±1%, 200 VDCW, 1/8 w. (Used in G1).
R221	19A702931P365	Metal film: 46.4K ohms ±1%, 200 VDCW, 1/8 w. (Used in G2).
R221	19A702931P358	Metal film: 39.2K ohms ±1%, 200 VDCW, 1/8 w. (Used in G1).
R222	19A702931P401	Metal film: 100K ohms ±1%, 200 VDCW, 1/8 w. (Used in G1).
R222	19A702931P409	Metal film: 121K ohms ±1%, 200 VDCW, 1/8 w. (Used in G2).
R223	19B801251P682	Metal film: 6.8K ohms ±5%, 1/10 w.
R224	19B801251P105	Metal film: 1M ohms ±5%, 1/10 w.
R225	19B801251P333	Metal film: 33K ohms ±5%, 1/10 w.
R226	19B801251P224	Metal film: 220K ohms ±5%, 1/10 w.
R227	19B801251P102	Metal film: 1K ohms ±5%, 1/10 w.
R228	19B801251P221	Metal film: 220 ohms ±5%, 1/10 w.
R229	19B801251P470	Metal film: 47 ohms ±5%, 1/10 w.
R230	19B800779P8	Variable, cermet: 4.7K ohms ±25%, .3 w.
R231	19B801251P473	Metal film: 47K ohms ±5%, 1/10 w.
R232	19B801251P100	Metal film: 10 ohms ±5%, 1/10 w.
R234	19B801251P470	Met.l film: 47 ohms ±5%, 1/10 w.
R235	19B801251P104	Metal film: 100K ohms ±5%, 1/10 w.
		- - - - - - - - - - INTEGRATED CIRCUITS - - - - - - - - - -
U201	19B800902P5	Synthesizer, custom: CMOS, serial input.
U202	19A149944P201	Prescaler: sim to Motorola MC12022A.
U203	19B801351P8	Crystal Oscillator.
U204	19C851913G1	Voltage Controlled Oscillator. (Used in G1).
U204	19C851913G2	Voltage Controlled Oscillator. (Used in G2).
U205	19A702705P4	Digital: Quad Analog Switch/Multiplexer: sim to 4066BM.
U206	19A702293P3	Linear: Dual Op Amp; sim to LM358D.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRODUCTION CHANGES

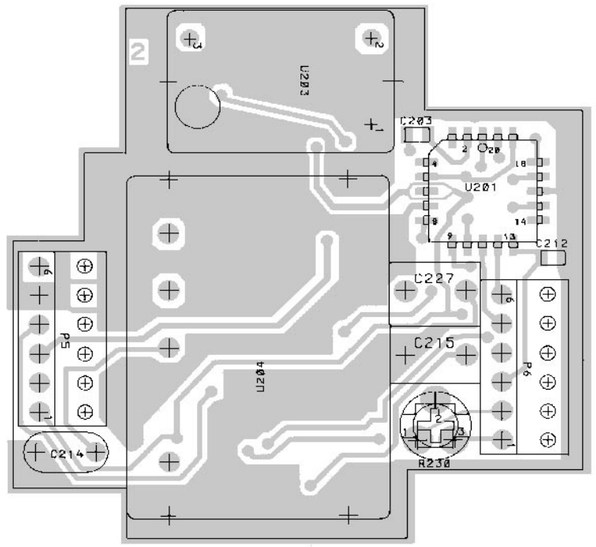
Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter", which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for the descriptions of parts affected by these revisions.

REV. A - SYNTHESIZER BOARD 19C851880G2
Incorporated in the initial shipment.

REV. B - SYNTHESIZER BOARD 19C851880G2
To reduce noise on the VCO supply line. Deleted R210 and changed C223.

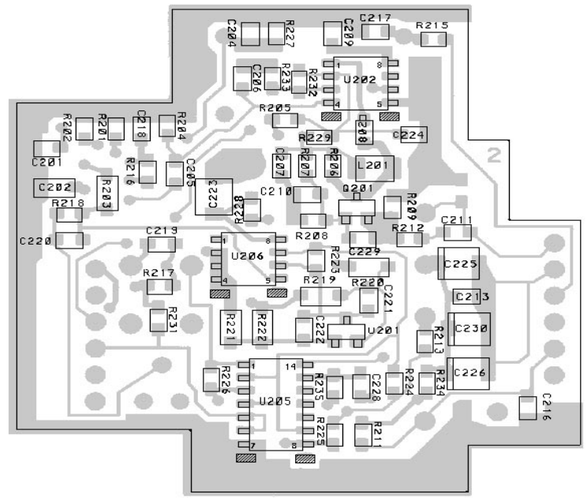
R210 was 19B801251P270 - Metal Film: 27 ohms ±5%, 1/10 w.
C223 was 19A705205P14 - Tantalum: 6.8 uF ±20%, 6 VDCW.

COMPONENT SIDE



(19C851880, Sh. 1, Rev. 4)
(19C851881, Component Side, Rev. 2)

SOLDER SIDE



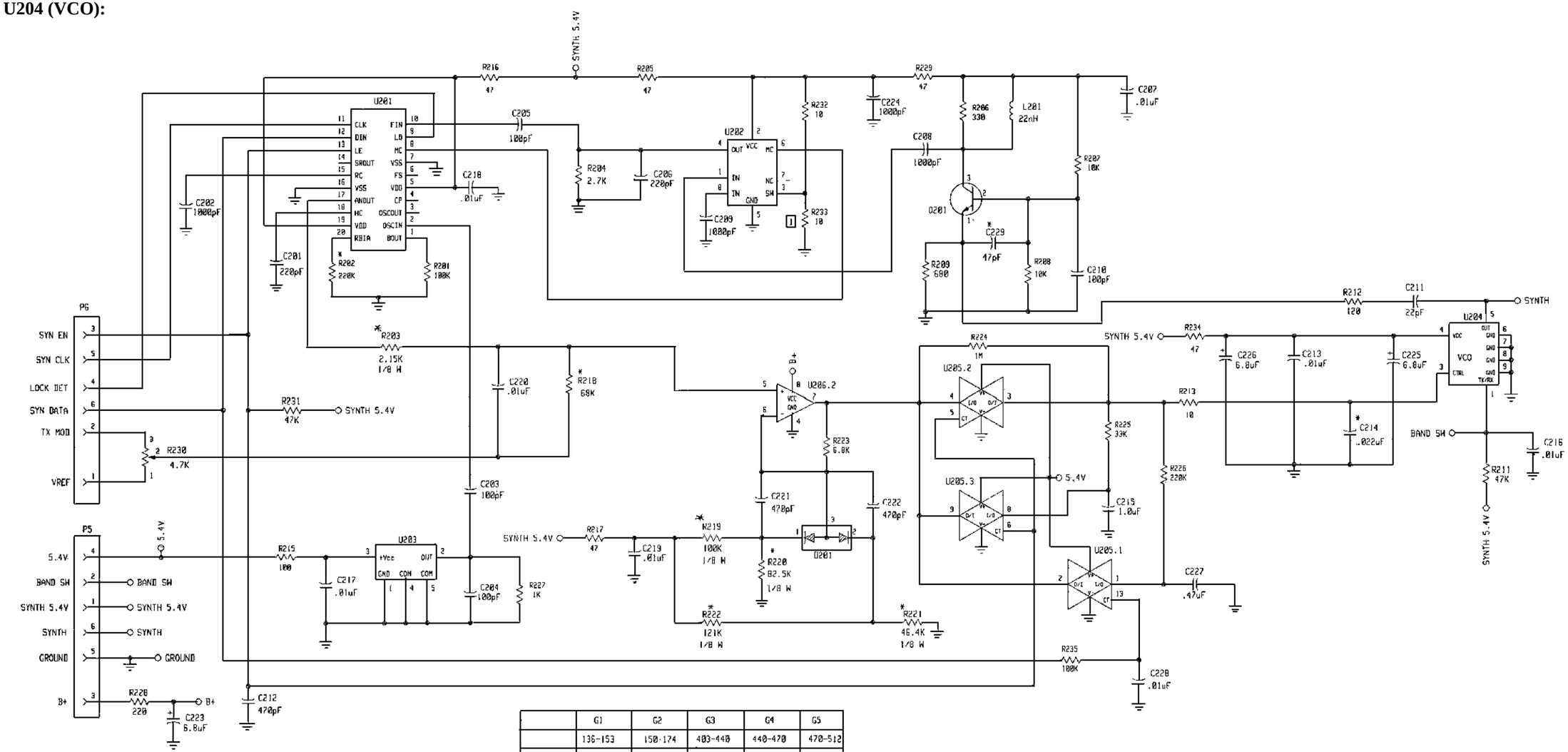
BACKSIDE VIEW

(19C851880, Sh. 1, Rev. 4)
(19C851881, Solder Side, Rev. 2)

SYNTHESIZER BOARD
19C851880G1 & G2

CAUTION
OBSERVE PRECAUTIONS FOR HANDLING
ELECTROSTATIC SENSITIVE DEVICES

U204 (VCO):



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CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER U, N OR P
INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER M OR U

THIS SCHEMATIC DIAGRAM APPLIES TO	
MODEL NO.	REV LETTER
19CB51880 G1	
19CB51880G2	B
19CB51880 G3	
19CB51880 G4	A
19CB51880G5	

	G1	G2	G3	G4	G5
	136-153	150-174	403-440	440-470	470-512
* C214	.022U	.022U	.047U	.033U	
* C229	4.7PF	47pf	——	——	
* R202	150K	220K	100K	100K	
* R218	68K	68K	150K	100K	
* R220	46.4K	82.5K	46.4K	68.1K	
* R221	39.2K	46.4K	39.2K	39.2K	
* R222	100K	121K	46.4K	121K	
* R203	3.16K	2.15K	2.15K	2.15K	
* R219	61.9K	100K	100K	100K	

PART	B+	5.4V	GND
U205		14	7
U206	8		4

NOTES:
[1] R233 REPLACES R232 IN CASES WHERE THE ALTERNATE PRESCALER DIVIDER RATIO IS REQUIRED. SEE MAINT.MANUAL FOR FURTHER INFORMATION.

SYNTHESIZER BOARD
19C851880G1 & G2