

TECHNICAL DESCRIPTION

PCB 611 SYNTHESIZER BOARD

45-75 MHz Synthesizer

The 45-75 MHz Synthesizer is of the Fractional-N type and has a frequency resolution of 10 Hz. The 40.96 kHz reference frequency derived from the Master Oscillator 612 is fed to both Phase Comparator and Phase/Frequency Comparator. Likewise the output signal of the Loop Divider is fed to both comparators. When the loop is locked the Phase/Frequency Comparator is turned off and there exists no difference in frequency, but a definite and time varying phase difference between the reference signal and the Loop Divider output signal. The Phase Comparator compares the phase of the two signals and if it differs from the steady state value, the Phase Comparator will produce a correction signal, which via the Loop Filter corrects the frequency and phase of the VCO until the steady state phase difference is reestablished. If the phase difference exceeds the limits of the Phase Comparator, for example during change of the synthesizer output frequency, the Phase/Frequency Comparator is automatically turned on. It will override the Phase Comparator by producing a correction signal which via the Loop Filter will alter the frequency and phase of the VCO until the difference between the reference signal and the Loop Divider output signal is well inside the working limits of the Phase Comparator. After a short amount of time the Phase/Frequency Comparator is turned off and the Phase Comparator takes over again ending up with the steady state locked condition. The Loop Filter is capable of changing parameters when required by means of four diodes. When the loop is locked the diodes are turned off, and in this condition the Loop Filter is designed to prevent noise modulation of the VCO and to give the loop a good dynamic response. During a major change in the synthesizer output frequency the diodes are turned on, and in this case the Loop Filter is designed to give the loop a fast dynamic response. The VCO covers a frequency range of 45-75 MHz which is divided in 4 bands. The bands are selected by the microprocessor on the Transceiver Control Board 624. The amplitude stabilized output signal of the VCO is split between two buffer amplifiers. One for the output signal of the synthesizer, which is led to the 1st mixer on the Rx/Ex Signal Path 610, the other buffer amplifier drives the input of the Loop Divider. The Transceiver Control Board determines the output frequency of the synthesizer by loading the corresponding division ratio into the Loop Divider and the Binary Accumulator. The integer part of the division ratio is stored in the Loop Divider and the fractional part is fed to the one input of the Binary Accumulator. The 12-bit Binary Accumulator enables 10 Hz resolution of the synthesizer output frequency. The output of the Binary Accumulator is fed back to one of its own inputs and in that way added to the fractional division ratio fed to the other input. The sum is transferred to the output of the Binary Accumulator when it receives an Accumulator Clock Signal. This happens in every period of the loop divider output frequency. When the sum exceeds the maximum capacity (4095) of the Binary Accumulator, it produces an Accumulator Carry Signal, and the remainder of the contents is kept for the next addition. The carry signal increases the division ratio of the Loop Divider by one. The loop will respond to this increase by producing an output frequency

corresponding to the fractional division ratio. The time varying phase difference between the reference signal and the loop divider output signal, caused by the said increase in the division ratio, is a function of the fractional division ratio. This function is derived from the output of the Binary Accumulator and converted into a current by the DA-Converter. The current is fed to the Phase Comparator where it cancels the signal produced by the time varying phase difference and thus preventing modulation of the VCO. The frequency information, loaded by the microprocessor on the Transceiver Control Board [624], is fed to the Ramp Current Generator, resulting in a current directly proportional to the output frequency of the synthesizer. As the Ramp Current controls the gain of the Phase Comparator, the dynamic response of the loop is held constant over the entire frequency range of the synthesizer. If the said cancellation of the time varying phase difference isn't complete, the Ramp Current Correction circuit measures the error at the Phase Comparator output and automatically adjusts the Ramp Current Generator until cancellation is obtained. Two signals derived from the Phase Comparator and the Phase/Frequency Comparator are combined in a check circuit with the check signals from the 43.6 MHz and 1.4 MHz Synthesizer resulting in a final check signal led to the Transceiver Control Board.

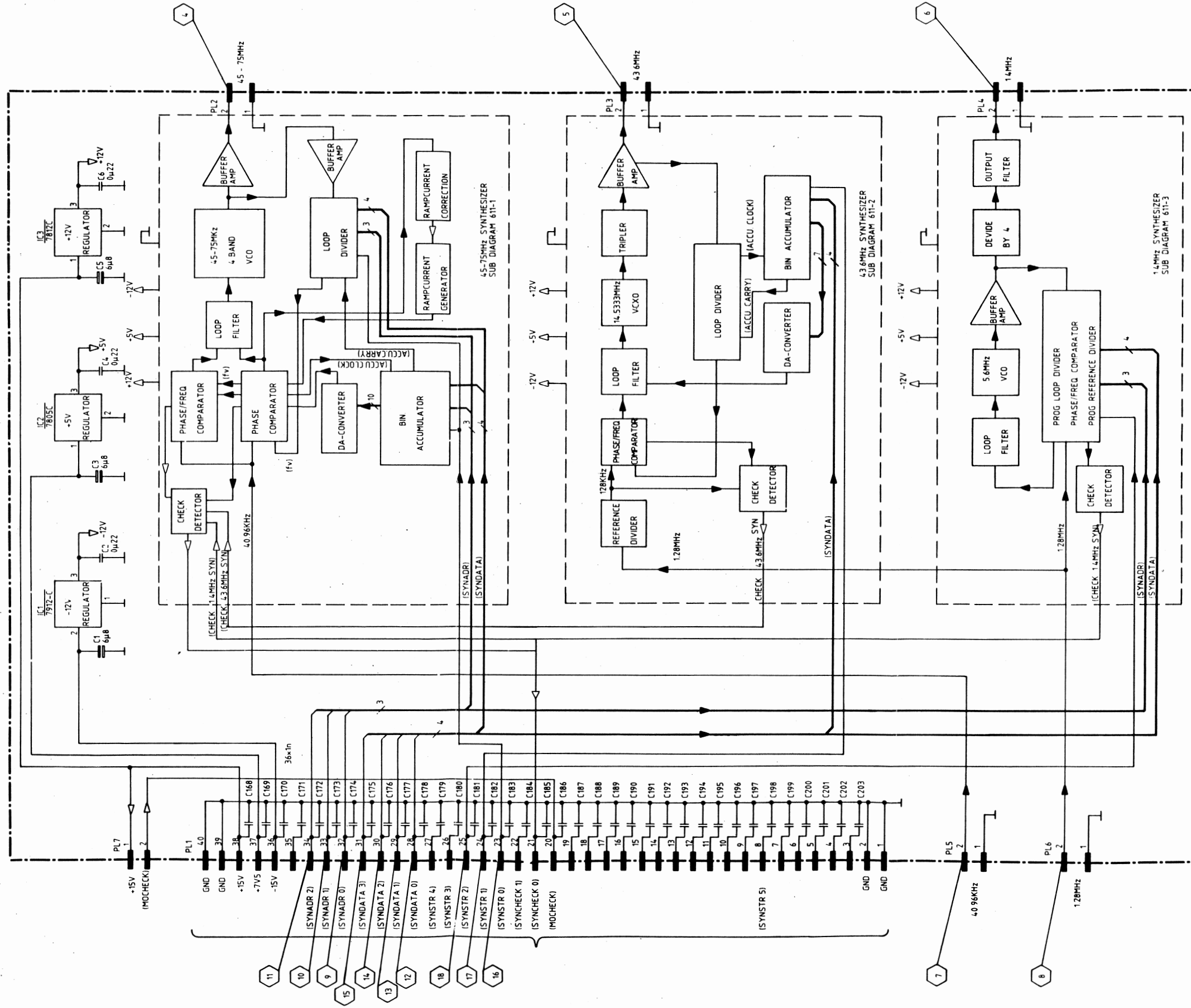
43.6 MHz Synthesizer

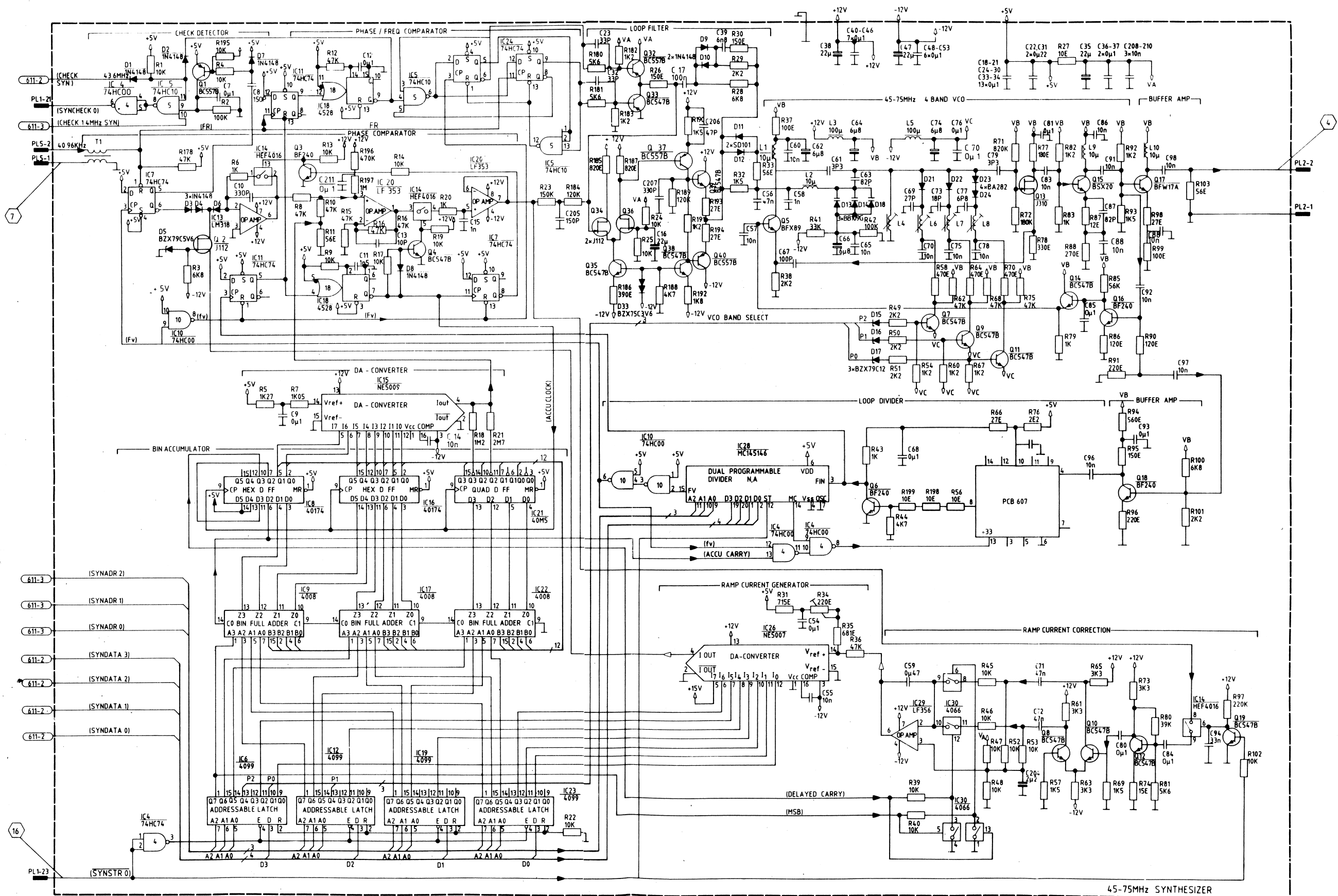
The synthesizer used is of the fractional-N type, which refers to the fact that the smallest step in output frequency is not equal to the reference frequency but a fractional part of this. From the Master Oscillator [612] a 1.28 MHz signal is led to the Reference Divider which divides the signal by 10 having a 128 kHz reference frequency at the input of the Phase/Frequency Comparator. The 128 kHz reference frequency and the output frequency of the Loop Divider are compared in the Phase/Frequency Comparator. When the loop is locked there exists no difference in frequency but a definite and time varying phase difference between the two signals. If the loop is out of lock the Phase/Frequency Comparator will produce a correction voltage which will alter the frequency and phase of the VCXO until the loop is back in the locked condition. The Loop Filter is designed to give the loop a good dynamic response and to stop noise modulation of the VCXO. The VCXO covers a frequency range of 14.53333 MHz +1.333 kHz/-1 kHz. The output signal of the VCXO is fed to the Tripler where the frequency is multiplied by 3, resulting in a synthesizer frequency of 43.6 MHz + 4 kHz - 3 kHz. The signal from the Tripler is amplified in the Buffer Amplifier and the level-stabilized output signal is led to the 2nd Mixer on the Rx/Ex Signal Path [610]. Another signal derived from the Buffer Amplifier is fed to the input of the Loop Divider. A 7-bit Binary Accumulator is incorporated in order to obtain a fractional division ratio in the loop, giving a 1 kHz step capability of the synthesizer output frequency. By loading the fractional division ratio into the input of the Binary Accumulator, the microprocessor on Transceiver Control Board determines the output frequency of the synthesizer. The other input of the Binary Accumulator is connected to its output. The two inputs are added and the sum is transferred to the output when the Binary Accumulator is clocked. The clock input is connected to the output of the Loop Divider. When the sum exceeds the maximum capacity (127) of the Binary Accumulator it produces an Accumulator Carry Signal which increases the ratio of the Loop Divider by one,

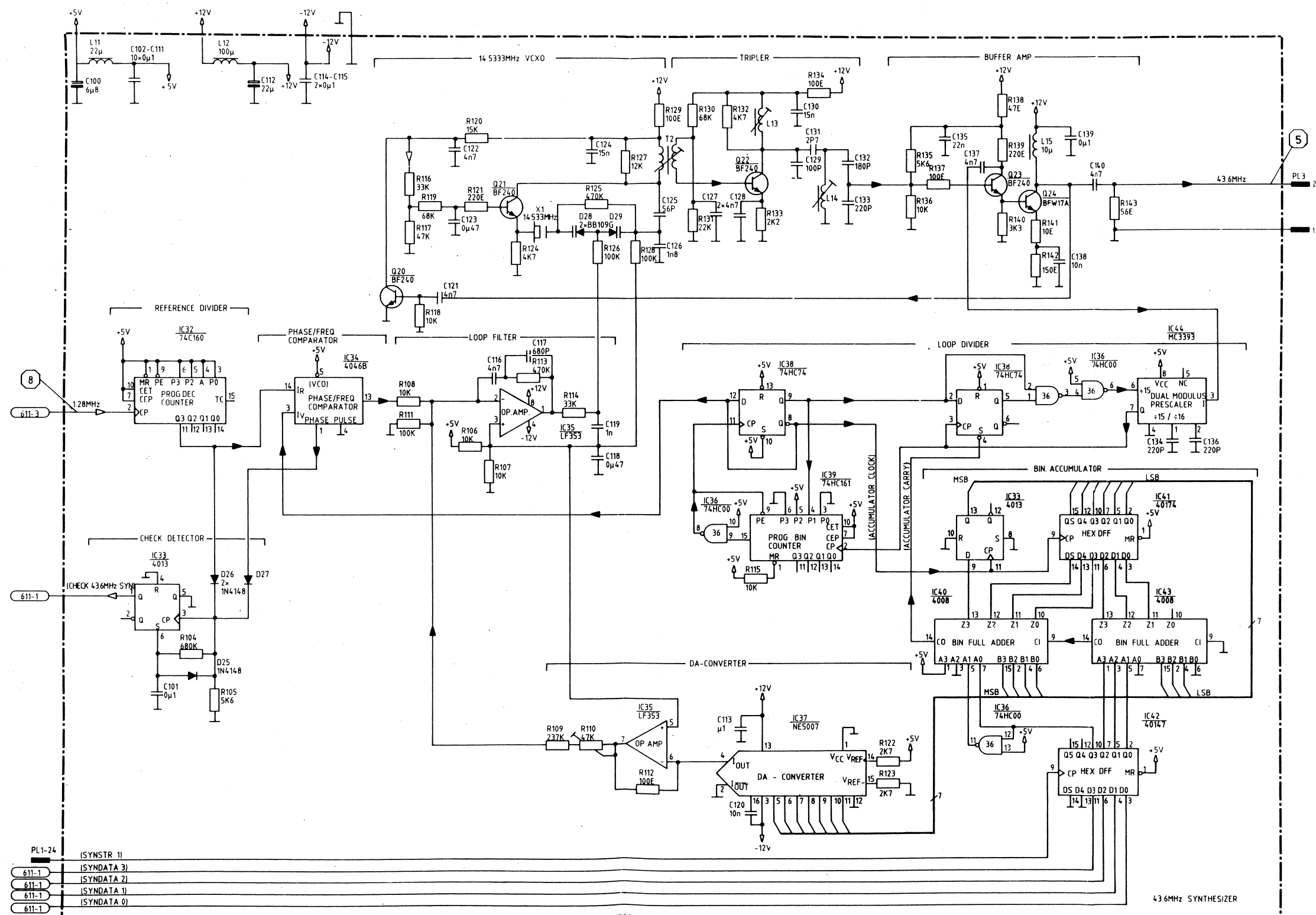
and the remainder of the accumulator contents is kept for the next addition. The loop responds to this increase by producing an output frequency corresponding to the fractional division ratio. As a result of the variation in the division ratio, the phase difference between the reference frequency and the output frequency of the Loop Divider will be varying and a function of the fractional division ratio. This function is derived from the output of the Binary Accumulator and converted into a voltage by the DA-converter. The output signal of the Phase/Frequency Comparator caused by time varying phase difference is canceled at the input of the Loop Filter by the output voltage of the DA-converter, and thus preventing modulation of the VCXO. The 128 kHz reference frequency and a signal derived from Phase/Frequency Comparator are combined in the Check Detector to give information of the synthesizer lock status.

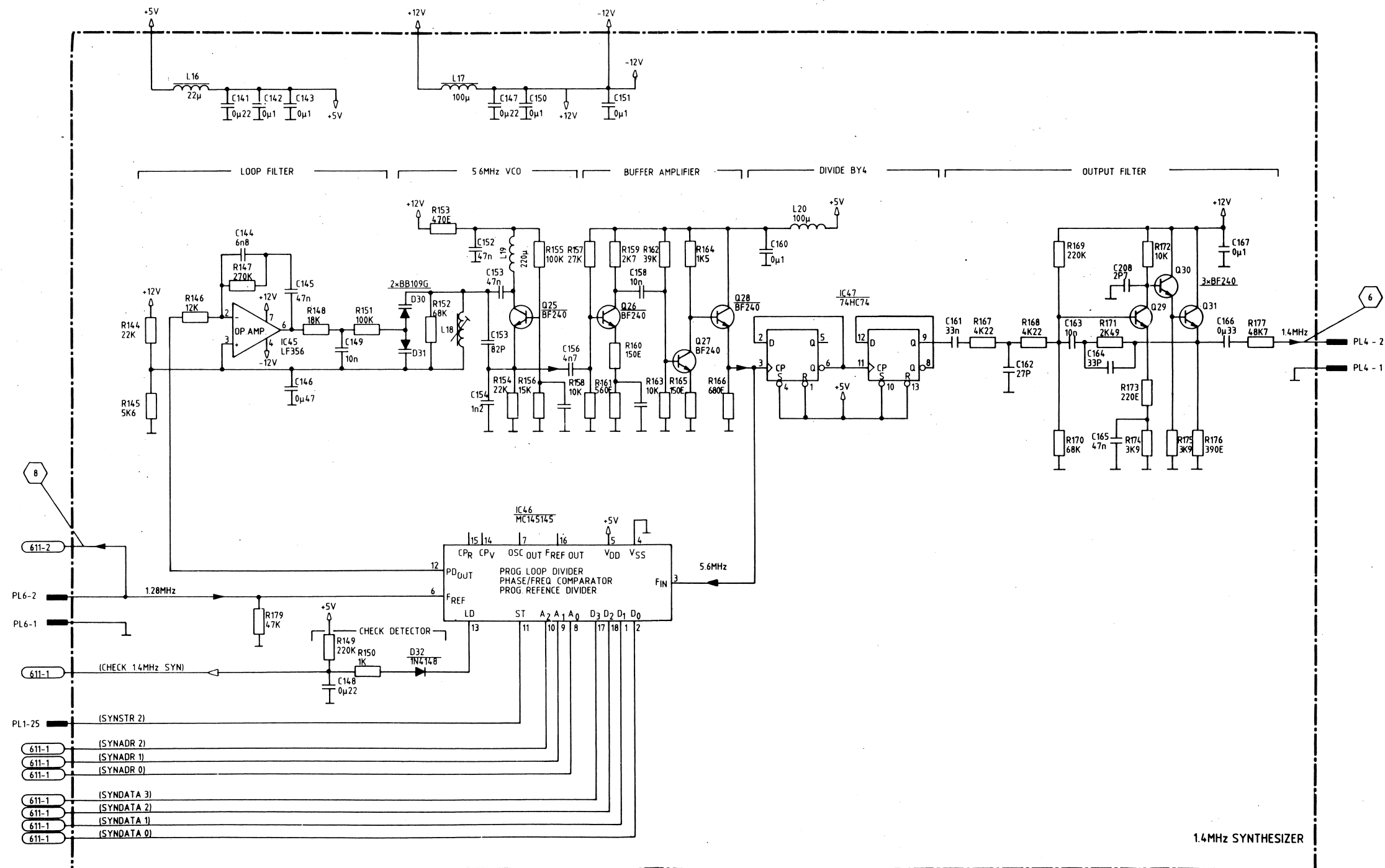
1.4 MHz Synthesizer

The synthesizer consists of a Loop Filter, a 5.6 MHz VCO, a Buffer Amplifier and a single integrated circuit which contains both Reference Divider, Loop Divider and Phase/Frequency Comparator. The division ratio of the Reference Divider and the Loop Divider are controlled by the microprocessor on the Transceiver Control Board [624]. A 1.28 MHz signal from the Master Oscillator [612] is fed to the input of the Reference Divider and divided by 3200, thus obtaining a reference frequency of 400 Hz as well as a frequency step size of 400 Hz for the synthesizer loop. The reference frequency and the Loop Divider output frequency are compared in the Phase/Frequency Comparator. In the locked condition there exists no difference between the two signals neither in frequency nor in phase. If a difference occurs, say during a change of the synthesizer output frequency, the Phase/Frequency Comparator will produce a correction voltage which will correct the frequency and phase of the VCO until the locked condition is obtained again. The Loop Filter is designed to give the loop a proper dynamic response and to prevent noise from modulating the VCO. The 5.6 MHz VCO covers the frequency range from 5.582 MHz to 5.612 MHz. The output signal of the VCO is amplified in the Buffer Amplifier and then split into two, one for the input of the Loop Divider and one for the Divide-by-4 circuit. The output frequency range of the Divide-by-4 circuit is 1.4 MHz + 3 kHz/4.5 kHz and the frequency step size is 100 Hz. The output signal of the Divide-by-4 circuit is fed to the Output Filter where the harmonics of the signal are reduced and the exact output level is set. The output signal is led to the 3rd Mixer on the Rx/Ex Signal Path [610]. A check detector is incorporated to indicate the lock status of the synthesizer.









TESTPOINTS FOR [611] SYNTHESIZER BOARD

1 -12V DC

2 +5V DC

3 +12V DC

4 OUTPUT 1.LO. 45-75Mhz synthesizer 1,5Vpp

SELF TEST #	F OUT
9	45 Mhz
10	52,5Mhz
11	52,5Mhz
12	60 Mhz

SELF TEST #	F OUT
13	60 Mhz
14	67,5 Mhz
15	67,5 Mhz
16	75 Mhz

5 OUTPUT 2.LO. 43,6Mhz SYNTHESIZER
SELF TEST # 17 F OUT=43,597 Mhz 2 Vpp
SELF TEST # 18 F OUT =43,603Mhz 2 Vpp

6 OUTPUT 3.LO. 14Mhz SYNTHESIZER
SELF TEST # 20 F OUT=1,3955 Mhz 650 mVpp
SELF TEST# 21 F OUT=1,403 Mhz 650 mVpp

7 40,96 KHz FROM MASTER OSCILLATOR

8 1,28 Mhz 5Vpp FROM MASTER OSCILLATOR

9 SYNADR 0 (IC 23 PIN 5)

10 SYNADR 1 (IC 23 PIN 6)

11 SYNADR 2 (IC 23 PIN 7)

12 SYNDATA 0 (IC 28 PIN 2)

13 SYNDATA 1 (IC 28 PIN 1)

14 SYNDATA 2 (IC 28 PIN 20)

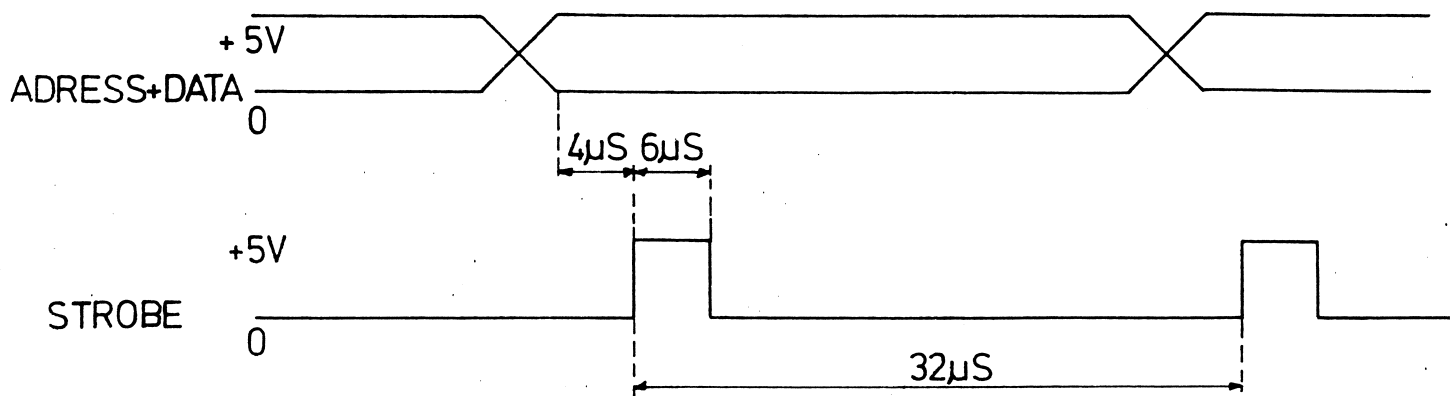
15 SYNDATA 3 (IC 28 PIN 19)

16 SYNSTR 0 (IC 28 PIN 12)

17 SYNSTR 1 (IC 42 PIN 9)

18 SYNSTR 2 (IC 46 PIN 11)

TIMING DIAGRAM



The strobe pulse is generated at each update of the frequency. e.g. the self test's # 9 to 21. or by repeating the test by pressing "DIM-MER DOWN".

PARTS LIST FOR SYNTHESIZER BOARD 611 VERSION 5A

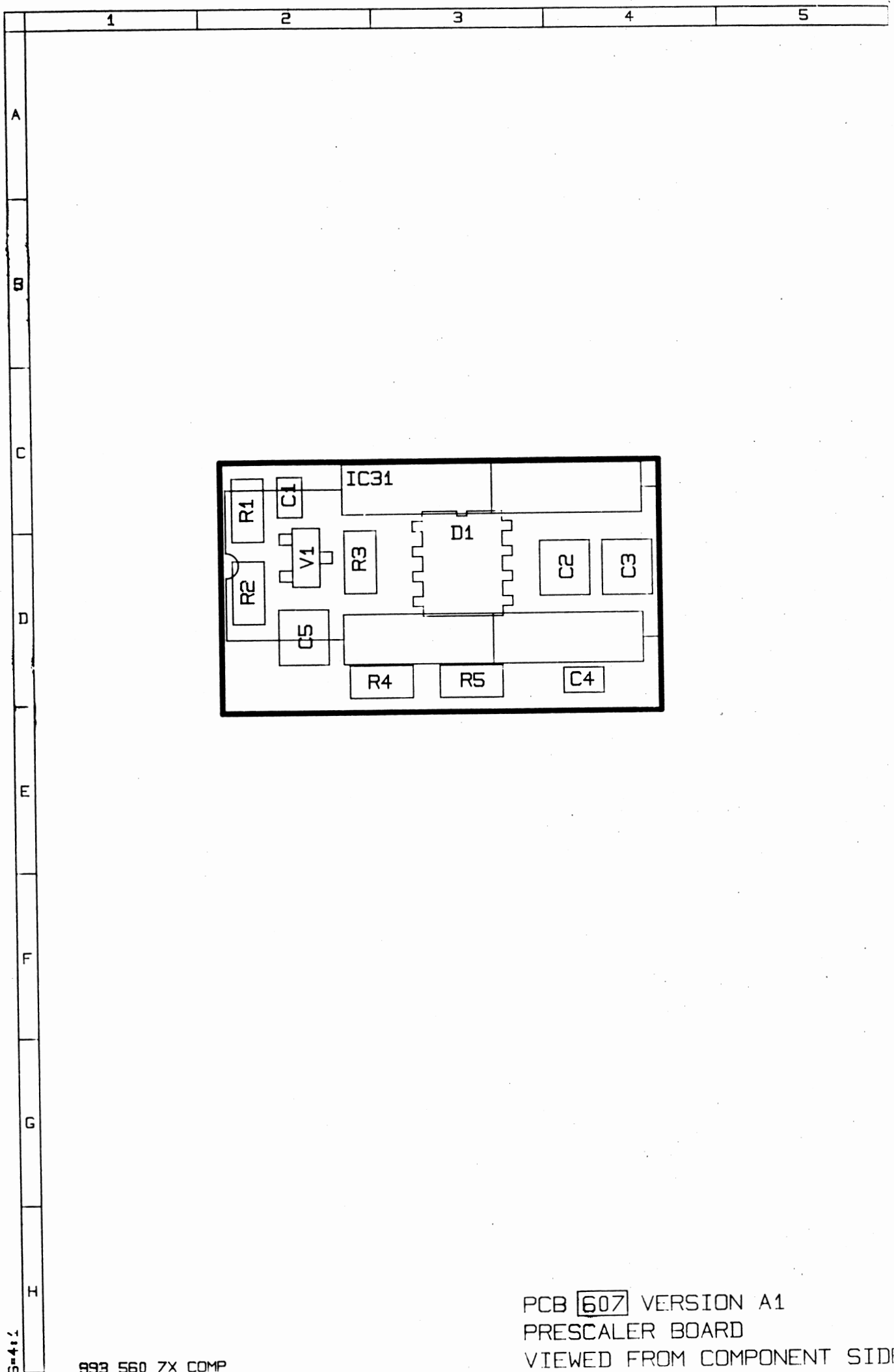
PARTS LIST FOR SYNTHESIZER BOARD 611 VERSION 5A

Printed Circuit Board Complete 611					
PCB	Prescaler PCB 607	107 561 11			
IC1	7912CU	107 560 71	D1-4,6-10, 25-27,32	1N4148	830 414 80
IC2	MA7805	850 791 20	D5	BZX79C5V6	832 795 61
IC3	MA7812	850 780 50	D11,12	SD101C	830 010 10
IC4,10,36	MC74HC00N	850 781 20	D13,14,18, 28-31	BB109	833 010 90
IC5	MC74HC10N	850 740 04	D15-17	BZX79C12	832 791 21
IC6,12,19,23	CD4099BCN	850 741 03	D21-24	BA282	830 028 20
IC7,11,24,38, 47	MC74HC74N	850 409 90	D33	BZX75C3V6	832 753 60
IC8,16,41,42	CD40174BCN	854 017 40	X1	14.5333MHZ	383 570 71
IC9,17,22,40, 43	CD4008BCN	850 400 80	R1,4,9,13,14, 17,19,22,24,25, 39,40,45-48, 52-53,102,106-108, 115,118,136,158,163, 172,195	10 kohm	5% 1/8W MF
IC13	LM318N	850 031 80	R2,42,111,126,128, 100 kohm		5% 1/8W MF
IC14	HEF4016BP	850 401 60	151,155		
IC15	NE5009N	850 500 90	R3,28,100	6.8 kohm	5% 1/8W MF
IC18	CD4528B	850 452 80	R5	1.27 kohm	1% 1/4W MF
IC20,35	LF353	850 035 30	R6,20,43,79,83, 150	1 kohm	5% 1/8W MF
IC21	CD40175BCN	854 017 50	R7	1.05 kohm	1% 1/4W MF
IC26,37	NE5007	850 500 70	R8,10,12,15,16, 36,62,68,75, 117,178,179	47 kohm	5% 1/8W MF
IC28	MC145146P	851 451 46			
IC29,45	LF356	850 035 60			
IC30	CD4066BC	850 406 60			
IC32	74C160	857 416 01			
IC33	CD4013B	850 401 30			
IC34	CD4046B	850 404 60			
IC39	MC74HCL61N	857 416 10			
IC44	MC3393P	850 339 30			
IC46	MC145145P	851 451 45			
Q1,32,37,40 Q2	BC557B J112	840 055 70 843 011 20			
Q3,6,16,18, 20-23,25-31	BF240	840 024 00			
Q4,7-12,14,19, 33,35,38,39	BC547B	840 054 70			
Q5	BFX89	840 089 00			
Q13	J310	840 031 03			
Q15	BSX20	840 002 00			
Q17,24	BFW17A	840 001 70			
Q34,36	J112 MATCHED	843 011 21			

PARTS LIST FOR SYNTHESIZER BOARD 611 VERSION 5A

PARTS LIST FOR SYNTHESIZER BOARD 611 VERSION 5A

R32,57,69,93, 164,190	1.5 kohm	5%	1/8W	MF	500 315 00	R44,124,132,188	4.7 kohm	5%	1/8W	MF	500 347 00
R34	220 ohm			Pot.	583 222 00	R127,146	12 kohm	5%	1/8W	MF	500 412 00
R35	681 ohm	1%	1/4W	MF	511 268 10	R131,144,154	22 kohm	5%	1/8W	MF	500 422 00
R37,112,129,134, 137	100 ohm	5%	1/8W	MF	500 210 00	R138	47 ohm	5%	1/8W	MF	500 147 00
R41,114,116	33 kohm	5%	1/8W	MF	500 433 00	R142	150 ohm	5%	1/2W	Car.	502 215 00
R185,187	820 ohm	5%	1/8W	MF	500 282 00	R147	270 kohm	5%	1/8W	MF	500 527 00
R54,60,67,82, 92,182,183,191	1.2 kohm	5%	1/8W	MF	500 312 00	R148	18 kohm	5%	1/8W	MF	500 418 00
R153	470 ohm	5%	1/8W	MF	500 247 00	R157	27 kohm	5%	1/8W	MF	500 427 00
R58,64,70	470 ohm	5%	1/2W	Car.	502 247 00	R94,161	560 ohm	5%	1/8W	MF	500 256 00
R61,63,65,73, 140,175	3.3 kohm	5%	1/8W	MF	500 333 00	R167,168	4.22 kohm	1%	1/4W	MF	511 342 20
R66,98,193,194	27 ohm	5%	1/8W	MF	500 127 00	R171	2.49 kohm	1%	1/4W	MF	511 234 90
R71	820 kohm	5%	1/8W	MF	500 582 00	R174	3.9 kohm	5%	1/8W	MF	500 339 00
R72	180 kohm	5%	1/8W	MF	500 518 00	R176,186	390 ohm	5%	1/8W	MF	500 239 00
R74	15 ohm	5%	1/4W	Car.	501 115 00	R177	48.7 ohm	1%	1/4W	MF	511 148 70
R76	2.2 ohm	5%	1/8W	MF	500 218 01	R184,189	120 kohm	5%	1/8W	MF	500 512 00
R77	180 ohm	5%	1/8W	MF	500 233 00	R192	1.8 kohm	5%	1/8W	MF	500 318 00
R78	330 ohm	5%	1/8W	MF	500 439 00	R197	1 Mohm	5%	1/8W	MF	500 610 00
R80,162	39 kohm	5%	1/8W	MF	500 356 00	C1,3,5	6.8 uF	-20+50%	25V	Sol.al.	652 668 01
R81,105,135,145, 180,181	5.6 kohm	5%	1/8W	MF	500 356 00	C2,4,6,22,31, 141,147,148	0.22 uF	10%	63V	Polyes.	622 522 01
R85	56 kohm	5%	1/8W	MF	500 456 00	C7,9,12,18-21, 24-30,33,34, 36-37,40-46, 48-54,68,76, 80-82,84-85, 93,101-111,113-115, 139,142-143, 150-151,160,167,211	0.1 uF	10%	63V	Polyes.	622 510 00
R86,90	120 ohm	5%	1/8W	MF	500 212 00	C8,205	150 pF	2%	63V	N150	602 215 00
R87	12 ohm	5%	1/8W	MF	500 112 00	C10	330 pF	1%	125V	Micro.	613 233 00
R88	270 ohm	5%	1/8W	MF	500 227 00	C11	1.5 nF	1%	500V	Micro.	613 315 00
R91,96,121,139, 173	220 ohm	5%	1/8W	MF	500 222 00	C14,55,57,60, 65,70,75,78,83, 86,88,91,92,96, 99,120,138,157, 159,163,208-210	10 nF	-20+50%	100V	Cer.	602 410 01
R166	680 ohm	5%	1/8W	MF	500 268 00	C13	10 pF	2%	63V	N150	602 110 00
R97,149,169	220 kohm	5%	1/8W	MF	500 522 00	C15,58,119	1 nF	1%	125V	Micro.	613 310 00
R99	100 ohm	5%	1/4W	Car.	501 210 00	C16,35,38,47, 112	22 uF	20%	25V	Tan.	652 722 00
R104	680 kohm	5%	1/4W	MF	500 568 00	C17	100 nF	10%	250V	MKP	624 510 02
R109	237 kohm	1%	1/4W	MF	511 523 70	C23,32,164	33 pF	2%	63V	N150	602 133 01
R110	47 kohm	5%	1/8W	Pot.	583 447 01						
R113,125,196	470 kohm	5%	1/8W	MF	500 547 00						
R119,130,170,152	68 kohm	5%	1/8W	MF	500 468 00						
R120,156	15 kohm	5%	1/8W	MF	500 415 00						
R122-123,159	2.7 kohm	5%	1/8W	MF	500 327 00						



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A

B

C

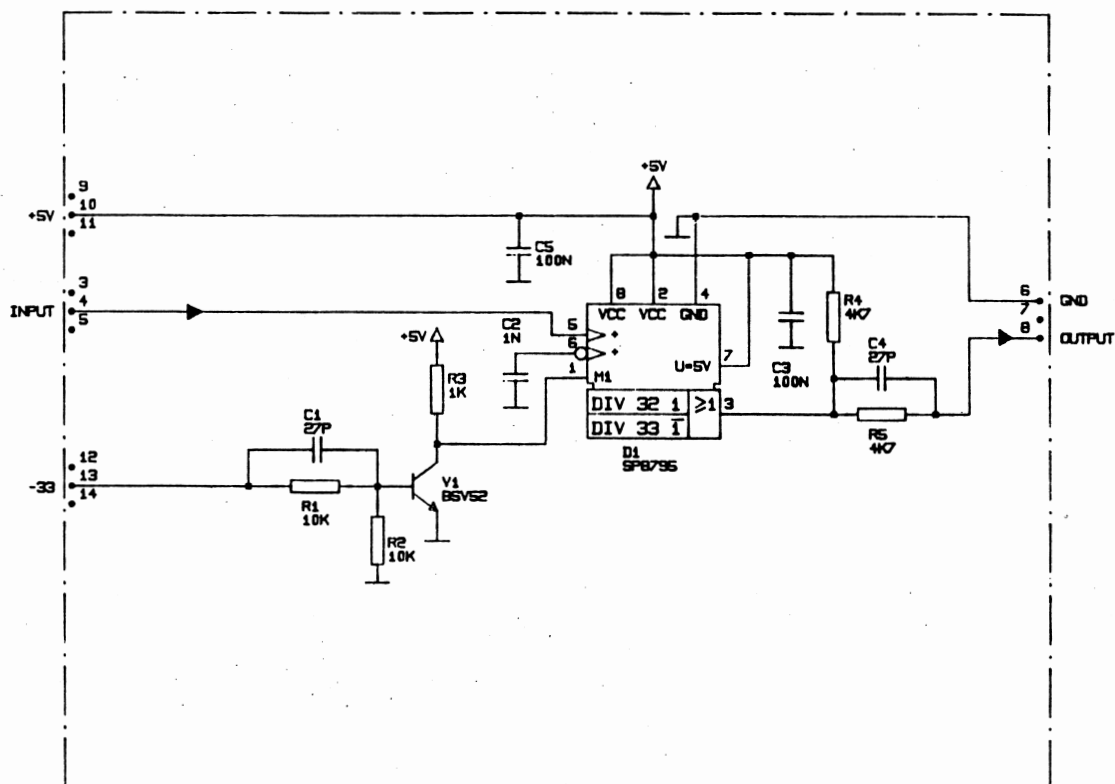
D

E

F

G

H



REPLACEMENT FOR IC31 SAA1059

PARTS LIST FOR PRESCALER BOARD 607 VERSION A1

C1	CAP	CER	27P	2%	50V	NP0	0805	67005900
C2	CAP	CER	1.0NF	2%	50V	NP0	1210	67003200
C3	CAP	SMD	100NF	10%		X7R	1210	67101100
C4	CAP	CER	27P	2%	50V	NP0	0805	67005900
C5	CAP	SMD	100NF	10%		X7R	1210	67101100
D1	COUNTER	SP8795						85990400
R1	RES	SMD	10K	5%	0.25W		1206	57002800
R2	RES	SMD	10K	5%	0.25W		1206	57002800
R3	RES	SMD	1K0	5%	0.25W		1206	57001800
R4	RES	SMD	4K7	5%	0.25W		1206	57002400
R5	RES	SMD	4K7	5%	0.25W		1206	57002400
V1	TRANS	BSV52		NPN	20V		SOT23	84720600