Timer/Counter/ Analyzers

PM6681, PM6681R & PM6681R/676/AF

Service Manual

FLUKE®

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GENERAL INFORMATION

This manual contains directions for use that apply to a number of models. In order to simplify references to certain models, the following designation system is used throughout the manual:

PM6681 stands for PM6681, PM6681R and PM6681R/676/AF
PM6681R stands for PM6681R and PM6681R/676/AF

The PM6681R/676/AF is a model supplied with the following features:

- PM6681R base model
- Prescaler PM9624 (2.7 GHz)
- Rackmount kit PM9622
- Reference output option PM9671B

Refer to the respective type numbers in the Operators Manual for specifications and other information not found in this manual.

New options and deviations from the original design are collectively treated in Chapter 9, Appendix. Below is a summary of the changes:

Unit 1

The main printed-circuit board (Unit 1) has recently been redesigned due to obsolescence of a number of integrated circuits. Designations found in circuit descriptions, schematic diagrams and parts lists in the first eight chapters refer to the original design. The functional descriptions are correct on the whole, if you make a few substitutions. A new set of schematic diagrams and a new replacement parts list are added in Chapter 9, Appendix.

- Instruments having serial numbers >784919 belong to the new generation.
- The model PM6681R/676/AF has only been produced with the new Unit 1 board, so the serial number is irrelevant.

Model PM6681R

The model PM6681R introduces an ultra-stable rubidium atomic clock reference.

Option PM9671B

Reference output unit offering six buffered 1 V_{rms} outputs with four different standard frequencies: 3 x 10 MHz, 1 x 5 MHz, 1 x1 MHz and 1 x 0.1 MHz.

New OCXOs

The PM9691 has been redesigned, and a version with very high stability , the PM9692, has been introduced.

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Chapter 1

Safety Instructions

WARNING: These servicing instructions are for use by qualified personnel only. To reduce the risk of electric shock, do not perform any servicing other than that specified in the Operating Manual unless you are fully qualified to do so.

Authorized service and calibration of this instrument is available worldwide. A list of service centers is printed on the last page of this manual.

Read this chapter carefully before you check, adjust or repair an instrument.

Caution and Warning Statements

You will find specific warning and caution statements where necessary throughout the manual.

CAUTION: Indicates where incorrect operating procedures can cause damage to, or destruction of, equipment or other property.

WARNING: Indicates a potential danger that requires correct procedures or practices in order to prevent personal injury.

This Timer/Counter has been designed and tested in accordance with safety class 1 requirements for Electronic Measuring Apparatus of IEC publication 1010-1, and CSA C22.2 No.231, and has been supplied in a safe condition.

This manual contains information and warnings that should be followed by the user and the service technician to ensure safe operation and repair in order to keep the instrument in a safe condition.

WARNING: The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts and accessible terminals which can cause death.

The instrument must be disconnected from all voltage sources before it is opened. Remember that the capacitors inside the instrument retain their charge even if the instrument has been disconnected from all voltage sources.

Grounding

This instrument is connected to ground via a sealed three-core power cable, which must be plugged into socket outlets with protective ground contacts. No other method of grounding is permitted for this instrument.

The ground symbol on the rear panel indicates where the protective ground lead is connected inside the instrument. Never remove or loosen this screw.

When the instrument is brought from a cold to a warm environment, condensation may cause hazardous conditions. Therefore, ensure that the grounding requirements are strictly met.

Power extension cables must always have a protective ground conductor.

Indicates that the operator should consult the manual.

WARNING: Any interruption of the protective ground conductor inside or outside the instrument, or disconnection of the protective ground terminal, is likely to make the instrument dangerous. Do not intentionally disrupt the protective grounding.

Disposal of Hazardous Materials

WARNING: Disposal of lithium batteries requires special attention. Do not expose the batteries to heat or put them under extensive pressure. These measures may cause the batteries to explode.

A lithium battery is used to power the non volatile RAM in this instrument. Our world suffers from pollution, so don't throw batteries into your wastebasket. Return used batteries to your supplier or to the Philips or Fluke organization in your country.

Line Voltage

The Timer/Counter can be powered by any voltage between 90 and 265 VAC without any range switching. This makes it suitable for all nominal line voltages between 100 and 240 V.

• *Replacing Components in Primary Circuits*

Components that are important for the safety of this instrument may only be replaced by components obtained from your local Philips or Fluke organization. After exchange of the primary circuits, perform the safety inspection and tests, as described in Chapter 5, "Repair".

• *Fuses*

This instrument is protected by an ordinary 1.6 A slow blow fuse mounted inside the instrument. NEVER replace this fuse without first examining the Power Supply Unit.

Chapter 2

Performance Check

General Information

WARNING: Before turning on the instrument, ensure that it has been installed in accordance with the Installation Instructions outlined in Chapter 1 of the Operators Manual.

This performance procedure is intended to:
- Check the instrument's specification.
- Be used for incoming inspection to determine the acceptability of newly purchased instruments and recently recalibrated instruments.
- Check the necessity of re calibration after the specified recalibration intervals.

NOTE: The procedure does not check every facet of the instrument's calibration; rather, it is concerned primarily with those parts of the instrument which are essential for determining the function of the instrument.

It is not necessary to remove the cover of the instrument to perform this procedure.

If the test is started less than 20 minutes after turning on the instrument, results may be out of specification, due to insufficient warm-up time.

Required Test Equipment

Type of instrument	Required Specifications	Suggested Instrument
LF Synthesizer	Square; Sine up to 2 MHz	PM5193
Digital Multimeter	to 300 V_{AC} & V_{DC}	PM2518; Fluke 77
Power Splitter		PM9584/02
T-piece		PM9067; Y9107
Termination	50 Ω	PM9585; Y9103
Low pass filter	50 kHz	PM9665B/01
Reference oscillator	10MHz $1*10^{-8}$ for 01 to 04 oscillator 5MHz $1*10^{-10}$ for 05 osc.	Philips counter with calibrated PM9691 PM 6685R *)
HF signal generator	to 2.1 GHz for PM9621, 5 GHz for PM9624 & 25	Fluke 6062A Wiltron 6717B-20 *)
Pulse Generator	to 125 MHz	PM5786B;PM5781
Oscilloscope with probes	350 MHz	PM3295
Power Supply	min 40 V_{DC}	PM2811/113, PE1537; PE1542
BNC-cables	5 to 7 cables	

Table 2-1 *Recommended Test Equipment*

*) This test equipment in needed if an option is installed.

Preparations

Power up your instruments at least 20 minutes before checking to let them reach normal operating temperature. Failure to do so may result in certain test steps not meeting equipment specifications.

Front Panel Controls

Power-On Test

At power-on the *timer/counter* performs an automatic self-test of the following:
- Microprocessor
- RAM
- ROM
- Measuring circuits

It also displays the GPIB address.

If there are any test failures, an error message is shown.

Internal Self-Tests

The built-in test programs from the power-on test can also be activated from the front panel as follows:
- Enter the Auxiliary Menu by pressing **AUX MENU**.
- Select the test submenu by pressing **SELECT** up or down.
- Enter the test menu by pressing the **ENTER** key.

Selections for internal self-tests are:

1 TEST RO (ROM)
2 TEST RA (RAM)
3 TEST ASIC (Measuring Logic)
4 TEST DISP (Display Test)
5 TEST ALL (Test 1 to 4 in sequence)

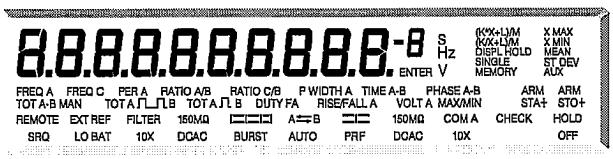

Figure 2-1 *Text on the display*

- Use **SELECT/SET** to select TEST ALL, then press **ENTER**.
- If any fault is detected, an error message appears on the display and the program halts.
- If no faults are detected, the program returns to measuring mode.

Keyboard Test

This test verifies that the *timer/counter* responds when you press any key. To check the function behind the keys, see the tests further on in this chapter.

Press the keys as described in the left column and look on the display for the text, as described in the second column. Some keys change more text on the display than described here. The display text mentioned here is the text mostly associated with the selected key.

NOTE: For the instrument to respond correctly, this test must be carried out in sequence and you must start with the Preset setting.

Key(s)	Display	Pass /Fail	Note
STAND-BY	Display Off		Red LED beside the key On
ON	----------		Backlight on
PRESET	preset ----------		Default setting
EXT REF	EXT REF		
Input A			
FILTER	FILTER		
50Ω/1MΩ	50 Ω		
**/ ⎍ **	\		
AC/DC	DC		
AUTO	1X		
1X/10X	10X		
SET A 1 . 7 3	1.73 V Enter		
ENTER	----------		
SWAP A ↔ B	A ⮌ B		
Input B			
**/ ⎍ **	\		
50Ω/1MΩ	50 Ω		
SET B 0 . 9 8 +/-	–0.98 V Enter		
ENTER	----------		
AC/DC	AC		
1X/10X	10X		
COM A	COM A		
HOLD OFF ON	HOLD OFF		
HOLD OFF SET	Hoff ti.		
PRESET	----------		
Other			
TIME	200^{-3} s		
SELECT ▲	500^{-3} s		
ENTER	----------		
HOLD	DISPL HOLD		
HOLD			
SINGLE	SINGLE		
FUNCTION ◀	*VOLT A MAX/MIN*		
FUNCTION ◀	*RISE/FALL A*		
FUNCTION ▶	*VOLT A MAX/MIN*		
FUNCTION ▶	*FREQ A*		
AUX MENU	Addr.		
RESTART	----------		
START ARM	Ar.Sta OFF		
RESTART	----------		
STOP ARM	Ar.StO OFF		
RESTART	----------		
PRESET	preset ----------		
CHECK	10000000006 *		Start counting
MATH **SELECT ▼** **ENTER**	Arith OFF Arith ON 10000000006 *		
K= **2**	10 2		
ENTER	20000000006 *		Counting
L= **Xn–1** **ENTER**	00 n-1 30000000006 *		Counting
L=	n-1		
0 ENTER	20000000006 *		Counting
L= Xo ENTER	40000000006 *		Counting
L=	20000000006 *		
4 EE 7 ENTER	24000000006 *		Counting
M= . 5	05		
ENTER	48000000006 *		Counting
STAT	Stat. OFF		
ENTER	48000000006 *		Counting
FUNCTION ◀ **(6 times)**	TOT A–B MAN		
TOT St/St	Gate LED lit		
MENU	Displays all available functions, processes and input controls. Selected items are blinking.		
PRESET	---------- **		Default setting

Table 2-2 *Keyboard test.*

* The LSD digit may vary.
** MENU is not disabled by setting DEFAULT, press menu again.

Short Form Specification Test

Sensitivity and Frequency Range

- Press the **PRESET** key to set the *timer/counter* in the default setting.
- Select 50 Ω input impedance and Non AUTO, (X1).
- Connect a signal from a HF generator to a BNC power splitter.
- Connect the power splitter to your counter and an oscilloscope.
- Set input impedance to 50 Ω on the oscilloscope.
- Adjust the amplitude according to the following table. Read the level on the oscilloscope. The *timer/counter* should display the correct frequency.

Frequency	Level			Pass/Fail	
MHz	mV_{PP}	mV_{RMS}	dBm	Input A	Input B
1	57	20	–21		
50	57	20	–21		
100	57	20	–21		
200	85	30	–17		Channel-B 100MHz
250	113	40	–15		
300	170	60	–11		

Table 2-3 *Sensitivity for A & B inputs at various frequencies*

- Connect the signal to input B.
- Select 50 Ω input impedance and SWAP A ↔ B on the counter.
- Repeat the above measurements for input B.

Check VMAX/VMIN

Check DAC for trigger level settings.

- Set your *timer/counter* in default setting by pressing **PRESET**.
- Select DC coupling, 1 MΩ input impedance and VOLT A MAX/MIN, but do not connect any input signal.
- The counter should now indicate:
  V_{MAX} = 0 ± 0.004V and V_{MIN} = 0 ± 0.004V.
- Connect a 4.00 V_{DC} level to channel A, using an external low pass filter on the input.
- The readings should be:
  V_{MAX} = 4.000 ± 0.044V, V_{MIN} = 4.000 ± 0.044V.
- Change the DC level to 40V.
- The counter should indicate:
  V_{MAX} = 40.0 ± 0.84V, V_{MIN} = 40.0 ± 0.84V.
- Repeat the measurement with inverted polarity.
- Press MATH and select (K*X+L)/M to change to Vpp measurements.
- Press ENTER.
- Connect a sinusoidal signal to channel A with an amplitude 4.00 V_{PP} and a frequency of 100 kHz.
- The indication should be 4.00 ± 0.244V.
- Change the amplitude to 18 V_{PP}.
- The display should read 18.0 ± 1.84V.
- Select SWAP A ↔ B, and connect the signal to channel B. Repeat the measurements for B as described above.

Trigger Indicators and Controls

NOTE: This test must be performed in the sequence given.

- Press the **PRESET** key to set the Timer/ Counter in the default setting.
- Select Non AUTO, X1 attenuation, and 1 MΩ input impedance for channel A.
- Connect the following signal to channel A:
  Sine, 10 kHz, 0.9 V_{PP}, and + 0.50 V_{DC}.
- Verify that the three modes for the trigger indicator are working properly by changing the trigger level:
  - Press the **SET A** key and enter **1** via the keyboard, then verify by pressing **ENTER**. Check the trigger indicator according to Table 2-4.
  - Press the **SET A** key and enter **–1** via the keyboard, then verify by pressing **ENTER**. Check the trigger indicator according to Table 2-4.
  - Press the **SET A** key and enter **0** via the keyboard, then verify by pressing **ENTER**. Check the trigger indicator according to Table 2-4.

Manually set trigger level	Trigger indicator	Pass/Fail	
		Input A	Input B
+1 V	off		
–1 V	on		
0.0 V	blinking		

Table 2-4 *Trigger indicator check*

- Select SWAP A ↔ B, and AC coupling on channel B, and repeat the exercise for channel B.

Trigger level check

- Deselect SWAP A ↔ B, connect the generator to channel A and check the trigger settings and indicators according to Table 2-5.

Trigger setting	Trigger indicator	Pass/Fail	
		Input A	Input B
SET A = 0 V	blinking		
DC coupling	on		
SET A = 0.7 V	blinking		
50 Ω Impedance	off		
SET A = 0.2 V	blinking		
AC coupling & 1 MΩ Impedance	blinking		
X10 Attenuation	off		
SET A = 0.0 V	blinking		
X1 Attenuation	blinking		

Table 2-5 *Trigger level check*

- Select A ↔ B
- Connect the signal to channel B.
- Select AC coupling on channel B, and repeat the previous settings for channel B.
- Connect the signal to channel A.
- Only the trigger indicator for channel A should be blinking.
- Press **COM A**.
- Both indicators should be blinking.
- Connect the signal to channel B.
- No trigger indicator should be blinking.

Reference Oscillators

X-tal oscillators are affected by a number of external conditions like ambient temperature and supply voltage but also by ageing. Therefore it is hard to give limits for the allowed frequency deviation. The user himself must decide the limits depending on his application, and recalibrate the oscillator accordingly. See the Preventive Maintenance chapter.

Oscillator	Max temperature dependence	Max ageing month	Max ageing year
Standard, 01	± 100 Hz	±5 Hz	±50 Hz
PM 9678B, 02	±10 Hz	±1 Hz	±5 Hz
PM 9690, 04	±0.15 Hz	±0.2 Hz	±1 Hz
PM 9691, 05	±0.05 Hz	±0.1 Hz	±0.75 Hz

Table 2-6 *Deviation (for PM 9690 and PM 9691 after 48 hours warm up time)*

To check the accuracy of the oscillator you must have a calibrated reference signal that is at least five times as stable as the oscillator that you are testing, see the following table. If you use a non 10 MHz reference, you can use the mathematics in PM 6681 to multiply the reading.

- Set the counter to default settings by pressing **PRESET**.
- Connect the reference to input A
- Check the readout against the accuracy requirements of your application.

• *Acceptance Test*

As an acceptance test the following table gives a worst case figure after 30 minutes warm up time. All deviations that can occur in a year are added together.

Oscillator	Frequency readout	Suitable reference	Pass /Fail
Standard, 01	10.00000000 MHz ± 150 Hz	PM 9678B	
PM 9678B, 02	10.00000000 MHz ± 15 Hz	PM 9690	
PM 9690, 04	10.00000000 MHz ± 2Hz	PM 6685B	
PM 9691, 05	10.00000000 MHz ± 1Hz	PM 6685B	

Table 2-7 *Acceptance test for oscillators*

Resolution Test

- Connect a pulse generator to a power splitter.
- Connect one side of the power splitter to the A input of the counter via a coaxial cable.
- Connect the other side of the power splitter to the B input of the counter.

Settings for the *pulse generator*:

- Amplitude = 1 V_{PP}, (high level +1V and low level 0V)
- Period approximately 1 µs
- Duration = approximately 50 ns
- Rise time 2 ns

Settings for the *timer/counter*, after Preset:

- Function = Time A-B
- Single
- Press **STAT** key under PROCESS
- Press **SELECT** key until display show 'ST DEV'.
- Meas Time = 50 µs
- A and B inputs:
  - 50 Ω input impedance
  - Non AUTO
  - Trigger level = 0.5V
  - DC coupling

The result should be (std dev) < 0.05^{-9} s.

Rear Input/Output

10 MHz OUT

- Connect an oscilloscope to the 10 MHz output on the rear of the counter. Use coaxial cable and 50 Ω termination.
- The output voltage is sine wave shaped and should be above 500 mV rms (1.4 V p-p).

GATE OPEN Output

- Set your *timer/counter* in Default setting by pressing the **PRESET.**
- Select CHECK, Non AUTO, and Meas Time = 5 ms.
- Connect the oscilloscope to the Gate Open output via a coaxial cable. Set the oscilloscope to 1ms/division.
- The Gate Monitor output should be a pulse similar to the Figure 2-2 .

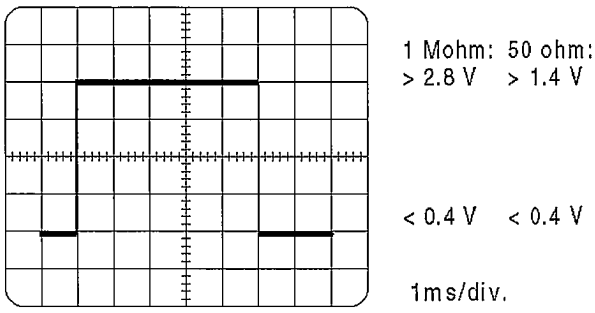

Figure 2-2 *Signal on gate open output*

REFERENCE IN

- Set the counter to Default Setting by pressing **PRESET.**
- Connect EXT REF out from another counter to input A.
- Connect a 10 MHz ± 100 Hz, 200 mV rms, (0.57 V p-p) signal to EXT REF IN at the rear, terminated with 50Ω.
- Select Ext Ref.
- The display should show 10 MHz.
- Change the input frequency to 5, 2, and 1 MHz respectivly.
- The display should still show 10 MHz.

EXT ARM input

- Select non AUTO.
- Settings for pulse generator: single shot pulse, amplitude TTL = 0 - 2 V_{PP}, and duration = 10 ns.
- Connect a pulse generator to EXT ARM input.
- Press **START ARM** key.
- Press **SELECT** key until display shows 'POS', confirm with **ENTER** key three times.
- The counter does not measure.
- Apply one single pulse to EXT ARM input.
- The counter measures once and shows 10 MHz on the display.

TRIG LEVEL A&B Outputs

- Press the **PRESET** key, to set the *timer/counter* in the default setting.
- Connect a voltmeter to TRIG LEVEL A(B) OUT at the rear.
- Set the Trigger Level (SET A/B) on the front to the following values, and verify the voltmeter's readout:

SET A(B)	Readout	Pass/Fail	
		Input A	Input B
+ 5.00 V	+ 5 V ± 0.28V		
– 5.00 V	– 5 V ± 0.28V		
0.00 V	0 V ± 0.03V		

Table 2-8 *Trigger level outputs check*

Probe Comp View

- Press the **PRESET** key to set the *timer/counter* in default setting.

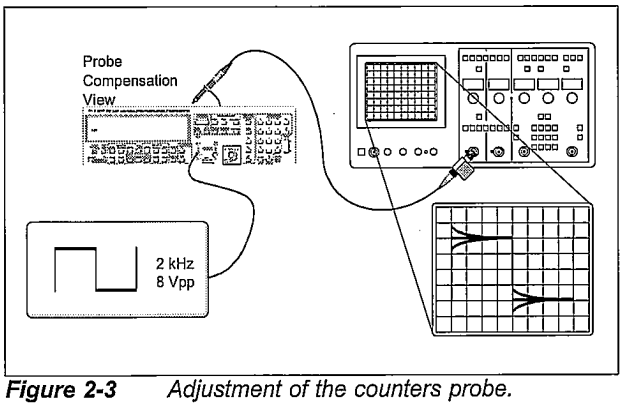

Figure 2-3 *Adjustment of the counters probe.*

- Select TIME A-B, non AUTO, X1 attenuation and DC coupling for both channels.
- Set the LF synthesizer to 2 kHz square wave and 8 V_{PP} amplitude.
- Connect synthesizer to Input A via a BNC-cable.
- Use an oscilloscope to check the signal at Probe Comp View, at the rear. The square wave will have the same step response and 4 V_{PP} amplitude.
- Select X10 attenuation.
- Check that the square wave is 2 kHz and 0.4 V_{PP}.
- Repeat this test for channel B.

Measuring Functions

Preparation for Check of Measuring Function:

- Press the **PRESET** key, to set the *timer/counter* in the default setting.
- Connect a 10 MHz sine wave signal with 2.0 V_{PP} amplitude to Input A.

Select the following settings for the *timer/counter*:

- 50 Ω input impedance for A and B
- Non AUTO
- COM A
- Check that the *timer/counter* performs the correct measurement, by displaying the result as shown under the "Display" column in Table 2-9.

Selected Function	Action	Display	Pass/ Fail
FREQ A		.10 MHz [2]	
FREQ C		---------- [3]	
PER A		100 $^{-9}$ s [2]	
RATIO A/B		10000000	
	Select NEG SLOPE B	10000000	
RATIO C/B		00000000	
PWIDTH A		50000 $^{-9}$ s [1]	
TIME A-B		50000 $^{-9}$ s [1]	
PHASE A-B		180 or -180 [1]	
TOT A-B MAN		0	
	Deselect COM A	0	
TOT ST/STOP		counting	
TOT ST/STOP		stop counting	
	Select COM A	0	
TOT A ⎍⎍ B		1	
TOT A ⎍ B		1	
	Select POS SLOPE B	0	
DUTY F A		0500000 [1]	
	Select AUTO	0500000 [1]	
RISE/FALL A		30000 $^{-9}$ s 2)	
VOLT MAX/MIN		+1000 -1000 V [2]	

Table 2-9 *Measuring functions check*

1) Value depends on the symmetry of the signal.

2) Exact value depends on input signal.

3) If an C-option is installed.

Check on HOLD OFF function

Press **PRESET** on the *timer/counter*.
Select the following settings for the *timer/counter*:
– Press CHECK.
– Select PER A.
– The counter should show 10^{-9} s*.
– Select HOLD OFF.
– The counter should show 1^{-6} s*.
– Set the Hold off time to 500^{-9} s.
– The counter should show 500^{-9} s*.
* The LSD digits may vary.

Options

Check on Prescalers

To verify the specification of the HF inputs in the instrument, perform the measurements below.

• PM 9621

Required Test Equipment	Suggested instrument
HF signal generator	Fluke 6062A

Table 2-10 *Test equipment for 1.3 GHz HF-input*

– Connect the output of the signal generator to the HF input of the counter.
– Connect the 10 MHz REFERENCE OUT of the generator to the REFERENCE IN at the rear panel of the counter.
Setting for the *timer/counter* after Preset.
– Function = FREQ C.
– EXT REF.

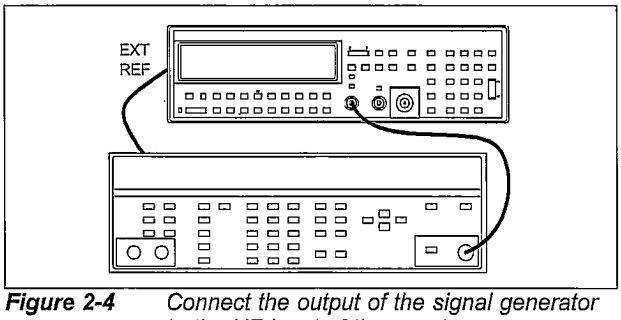

Figure 2-4 *Connect the output of the signal generator to the HF-input of the counter.*

– Generate a sine wave in accordance with the corresponding table below.

Frequency	Amplitude		Pass/Fail
MHz	mV_{RMS}	dBm	
70-900	10	–27	
-1100	15	–23	
-1300	40	–15	

Table 2-11 *Sensitivity of PM 9621*

– Verify that the counter counts correctly. (The last digit will be unstable).

• PM 9624, PM 9625B, or PM 9625

Required Test Equipment	Suggested instrument
HF signal generator	Wiltron 6717B-20

Table 2-12 *Test equipment for 2.7, 4.2, and 4.5 GHz HF-inputs*

– Connect the output of the signal generator to the HF input of the counter.
– Connect the 10 MHz REFERENCE OUT of the generator to the REFERENCE IN at the rear panel of the counter.
Setting for the *timer/counter* after Preset.
– Function = FREQ C.
– EXT REF.

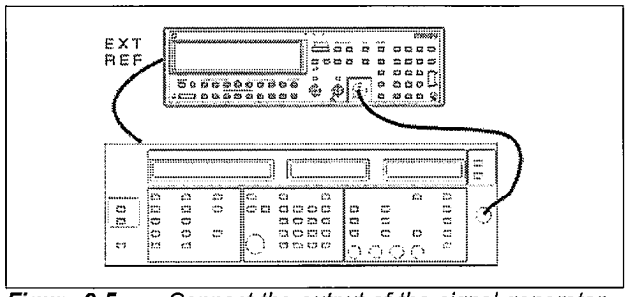

Figure 2-5 *Connect the output of the signal generator to the HF-input of the counter.*

– Generate a sine wave in accordance with the corresponding tables below.

Frequency	Amplitude		Pass/Fail
MHz	mV_{RMS}	dBm	
100-300	20	–21	
-2500	10	–27	
-2700	20	–21	

Table 2-13 *Sensitivity of PM 9624.*

Frequency	Amplitude		Pass/Fail
MHz	mV_{RMS}	dBm	
150-300	20	–21	
-2200	10	–27	
-3500	15	–23.5	
-4200	25	–19	

Table 2-14 *Sensitivity of PM 9625B.*

Frequency	Amplitude		Pass/Fail
MHz	mV_{RMS}	dBm	
150-300	20	–21	
-2500	10	–27	
-3500	15	–23.5	
-4200	25	–19	
-4500	50	–13	

Table 2-15 *Sensitivity of PM 9625.*

– Verify that the counter counts correctly. (The last digit will be unstable).

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PM 6681 Performance Check Report

Power-On Test (page 2-2)	Pass	Fail

Internal Self-tests (page 2-2)	Pass	Fail

Keyboard Test (page 2-3)			
Key(s)	Display	Pass	Fail
STAND-BY	Display Off		
ON	- - - - - - - - - -		
PRESET	PrESEt - - - - - - - - - -		
EXT REF	EXT REF		
Input A			
FILTER	FILTER		
50 Ω/1MΩ	50 Ω		
/‾\	_/		
AC&DC	DC		
AUTO	1X		
1X/10X	10X10X		
SET A 1 . 7 3	1.73 V Enter		
ENTER	- - - - - - - - - -		
SWAP A ↔ B	A ⇆ B		
Input B			
/‾\	_/		
50 Ω/1MΩ	50 W		
SET B 0 . 9 8 +/–	–0.98 V Enter		
ENTER	- - - - - - - - - -		
AC/DC	AC		
1X/10X	10X		
COM A	COM A		
HOLD OFF ON	HOLD OFF		
HOLD OFF SET	hoff ti		

Keyboard Test (page 2-3)			
Key(s)	Display	Pass	Fail
PRESET	- - - - - - - - - -		
Other			
PRESET	Preset - - - - - - - - - -		
MEAS TIME SET	200^{-3} s		
SELECT ▲	500^{-3} s		
ENTER	- - - - - - - - - -		
HOLD	DISPL HOLD		
HOLD			
SINGLE	SINGLE		
FUNCTION◀	*VOLT A MAX/MIN*		
FUNCTION◀	*RISE/FALL A*		
FUNCTION▶	*VOLT A MAX/MIN*		
FUNCTION▶	*FREQ A*		
AUX MENU	Addr		
RESTART	- - - - - - - - - -		
PRESET ENTER	- - - - - - - - - -		
STARTARM	Ar.Sta Off		
RESTART	- - - - - - - - - -		
STOPARM	Ar.StO OFF		
RESTART	- - - - - - - - - -		
PRESET	Preset - - - - - - - - - -		
CHECK	1000000000^{6}		
MATH SELECT ▼ ENTER	Arith OFF Arith ON 1000000000^{6}*		
K= 2	10 2		
ENTER	2000000000^{6}*		
L= Xn-1 ENTER	00 n-1 3000000000^{6}*		
L=	n-1		

Keyboard Test (page 2-3)

Key(s)	Display	Pass	Fail
0 ENTER	2 0 0 0 0 0 0 0 0 0 ^{6} *		
L= Xo ENTER	4 0 0 0 0 0 0 0 0 0 ^{6} *		
L=	2 0 0 0 0 0 0 0 0 0 ^{6} *		
4 EE 6 ENTER	2 4 0 0 0 0 0 0 0 0 ^{6} *		
M= . 5	0 5		
ENTER	4 8 0 0 0 0 0 0 0 0 ^{6} *		
STAT	Stat.OFF		
ENTER	4 8 0 0 0 0 0 0 0 0 ^{6} *		
FUNCTION ◀ (6 times)	*TOT A-B MAN*		
TOT St/St	Gate LED lit		
MENU	Displays all available functions, processes and input controls. Selected items are blinking.		
PRESET ENTER	– – – – – – – – – – – – **		

*) The LSD digit may vary.

**) MENU is not disabled by setting DEAFULT, press menu again.

Sensitivity and Frequency Range (page 2-4)

Frequency	Level	Measure value	Pass	Fail
Input A				
1 MHz	20 mV_{RMS} –21 dBm			
50 MHz	20 mV_{RMS} –21 dBm			
100 MHz	20 mV_{RMS} –21 dBm			
200 MHz	30 mV_{RMS} –17 dBm			
250 MHz	40 mV_{RMS} –15 dBm			
300 MHz	60 mV_{RMS} –11 dBm			
Input B				
1 MHz	20 mV_{RMS} –21 dBm			
50 MHz	20 mV_{RMS} –21 dBm			
100 MHz	20 mV_{RMS} –21 dBm			

Check VMAX/VMIN (page 2-4)

Input signal	Level V_{MAX} V_{MIN}	Measured value	Pass	Fail
Input A				
None	0 ±4 mV			
	0 ±4 mV			
4.00 V_{DC}	4.000 ±0.044 V			
	4.000 ±0.044 V			
40 V_{DC}	40 ±0.84 V			
	40 ±0.84 V			
–4.00 V_{DC}	–4.000 ±0.044 V			
	–4.000 ±0.044 V			
–40 V_{DC}	–40 ±0.84 V			
	–40 ±0.84 V			
4.00 V_{PP}	4.00 ±0.244 V			
18 V_{PP}	18 ±1.84 V			
Input B				
None	0 ±4 mV			
	0 ±4 mV			
4.00 V_{DC}	4.000 ±0.044 V			
	4.000 ±0.044 V			
40 V_{DC}	40 ±0.84 V			
	40 ±0.84 V			
–4.00 V_{DC}	–4.000 ±0.044 V			
	–4.000 ±0.044 V			
–40 V_{DC}	–40 ±0.84 V			
	–40 ±0.84 V			
4.00 V_{PP}	4.00 ±0.244 V			
18 V_{PP}	18 ±1.84 V			

Trigger Indicator (page 2-4)

Manually set trigger level	Trigger indicator	Pass	Fail
Input A			
+ 1 V	off		
– 1 V	on		
0.0 V	blinking		
Input B			
+ 1 V	off		
– 1 V	on		
0.0 V	blinking		

Trigger Level
(page 2-4)

Trigger setting	Trigger indicator	Pass	Fail
Input A			
SET A = 0 V	blinking		
DC coupling	on		
SET A = 0.7 V	blinking		
50 Ω Impedance	off		
SET A = 0.2 V	blinking		
AC coupling & 1 MΩ Impedance	blinking		
X10 Attenuation	off		
SET A = 0.0 V	blinking		
X1 Attenuation	blinking		
Input B			
SET B = 0 V	blinking		
DC coupling	on		
SET B = 0.7 V	blinking		
50 Ω Impedance	off		
SET B = 0.2 V	blinking		
AC coupling & 1 MΩ Impedance	blinking		
X10 Attenuation	off		
SET B = 0.0 V	blinking		
X1 Attenuation	blinking		

Reference Oscillators
(page 2-5)

Oscillator	Frequency readout	Measured value	Pass	Fail
Standard, 01	10.00000000 MHz ± 150 Hz			
PM 9678B 02	10.00000000 MHz ± 15 Hz			
PM 9690, 04	10.00000000 MHz ± 2 Hz			
PM 9691, 05	10.00000000 MHz ± 1 Hz			

Resolution Test
(page 2-5)

Readout	Pass	Fail
$< 0.05^{-9}$ s		

Rear Input/Output
(page 2-5)

Function	Readout	Measured value	Pass	Fail
EXT REF OUT	>1.4 V_{PP} 500 Vrms			
GATE OPEN Output	—			
REFERENCE IN	10.00000000^{-6} Hz ±5 LSD			
EXT ARM Input	—			

Trig Level Outputs
(page 2-6)

SET A(B)	Readout	Measured value	Pass	Fail
Input A				
+ 5.00 V	+ 5 V ±0.28 V			
− 5.00 V	− 5 V ±0.28 V			
0.00 V	0 V ±30 mV			
Input B				
+ 5.00 V	+ 5 V ±0.28 V			
− 5.00 V	− 5 V ±0.28 V			
0.00 V	0 V ±30 mV			

Probe Comp View
(page 2-6)

Attenuator	Oscilloscope readout	Measured value	Pass	Fail
Input A				
X1	2 kHz, 4 V_{PP}			
X10	2 kHz, 0.4 V_{PP}			
Input B				
X1	2 kHz, 4 V_{PP}			
X10	2 kHz, 0.4 V_{PP}			

Measuring Functions (page 2-6)				
Selected Function	Display	Measured value	Pass	Fail
FREQ A	10 MHz [2]			
FREQ C	- - - - - - - - [2]			
PER A	100 $^{-9}$ s [2]			
RATIO A/B	10000000			
NEG SLOPE B				
RATIO C/B	00000000			
PWIDTH A	50000 $^{-9}$ s [1]			
TIME A-B	50000 $^{-9}$ s [1]			
PHASE A-B	180 or -180 [1]			
TOT A-B MAN	0			
Not COM A	0			
TOT ST/STOP	counting			
TOT ST/STOP	stop counting			
COM A	0			
TOT A ⎍⎍⎍ *B*	1			
TOT A ⎍_⎍ *B*	1			
POS SLOPE B	0			
DUTY F A	0500000 [1]			
AUTO	0500000 [1]			
RISE/FALL	30000 $^{-9}$ s [2]			
VOLT A MAX/MIN	+1000 -1000 V			

1) Value depends on the symmetry of the signal.

2) Exact value depends on input signal.

HOLD OFF (page 2-7)				
Hold Off	Readout	Measured value	Pass	Fail
Off	10 $^{-9}$ s			
1 -6 s	1 $^{-6}$ s			
500 -9 s	500 $^{-9}$ s			

Sensitivity of PM 9621 (page 2-7)				
Frequency	Amplitude	Measured value	Pass	Fail
70-900 MHz	10 mV_{RMS} –27 dBm			
-1100 MHz	15 mV_{RMS} –23 dBm			
-1300 MHz	40 mV_{RMS} –15 dBm			

Sensitivity of PM 9624 (page 2-7)				
Frequency	Amplitude	Measured value	Pass	Fail
100-300 MHz	20 mV_{RMS} –21 dBm			
-2500 MHz	10 mV_{RMS} –27 dBm			
-2700 MHz	20 mV_{RMS} –21 dBm			

Sensitivity of PM 9625B (page 2-7)				
Frequency	Amplitude	Measured value	Pass	Fail
150-300 MHz	20 mV_{RMS} –21 dBm			
-2200 MHz	10 mV_{RMS} –27 dBm			
-3500 MHz	15 mV_{RMS} –23.5 dBm			
-4200 MHz	25 mV_{RMS} –19 dBm			

Sensitivity of PM 9625 (page 2-7)				
Frequency	Amplitude	Measured value	Pass	Fail
150-300 MHz	20 mV_{RMS} –21 dBm			
-2500 MHz	10 mV_{RMS} –27 dBm			
-3500 MHz	15 mV_{RMS} –23.5 dBm			
-4200 MHz	25 mV_{RMS} –19 dBm			
-4500 MHz	50 mV_{RMS} –13 dBm			

Total Performance check		
	Pass	Fail
Date:		
Test performed by:		

Chapter 3

Disassembly

The terms in the following figure are used in all descriptions in this manual.

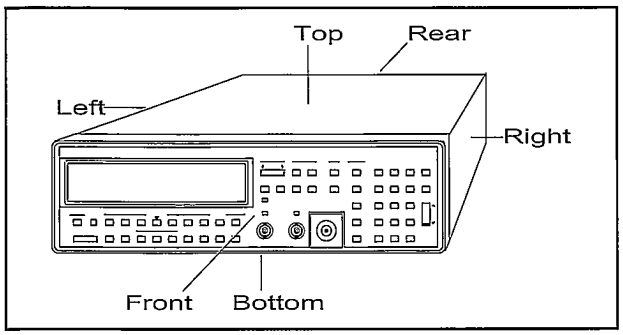

Figure 3-1 *Terms used in this manual.*

The PM 6681 is available with a number of options and accessories. The labels on the rear panel of the counter identify the options and accessories included. If there are no labels, the counter contains an uncompensated crystal oscillator and no options. The following labels exist:

PM 9611/81 Rear Panel Inputs

PM 9621 1.3 GHz HF input

PM 9624 2.7 GHz HF input

PM 9625 4.5 GHz HF input

PM 9678B TCXO

PM 9690 Oven Oscillator

PM 9691 Oven Oscillator

The location of these optional parts is illustrated in Fig. 3-2.

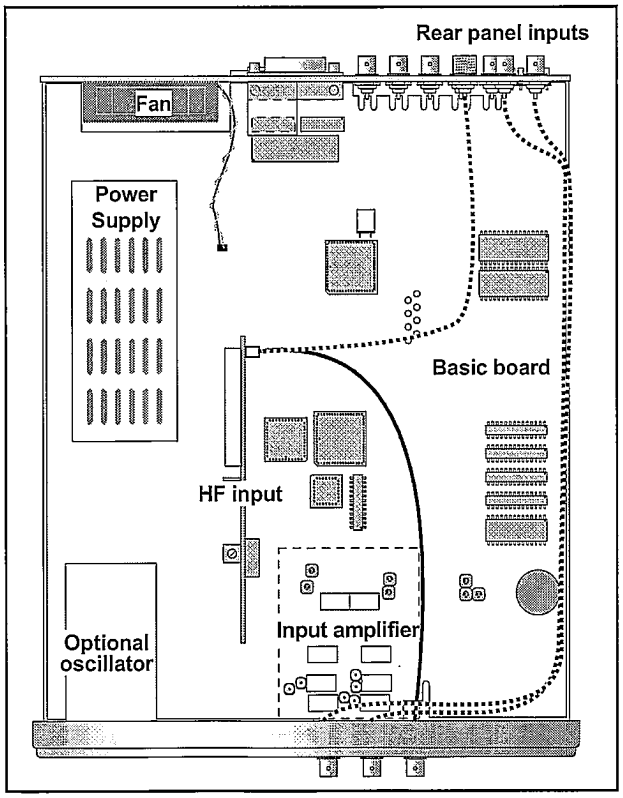

Figure 3-2 *Location of the boards in the counter.*

Removing the Cover

WARNING: Do not perform any internal service or adjustment of this instrument unless you are qualifyed to do so.

WARNING: When you remove the cover you will expose live parts and accessible terminals which can cause death.

WARNING: Although the power switch is in the off position, line voltage is present on the printed circuit board. Use extreme caution.

WARNING: Capacitors inside the instrument can hold their charge even if the instrument has been separated from all voltage sources.

- Make sure the power cord is disconnected from the counter.
- Turn the counter upside down.
- Loosen the screw **(A)** at the bottom and the two screws **(B)** in the rear feet.
- Grip the front panel and gently push at the rear.
- Pull the counter out of the cover.

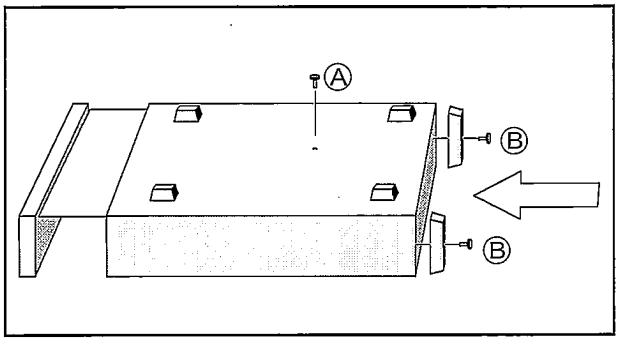

Figure 3-3 *Remove the screws and push out the counter from the cover.*

Reinstalling the Cover

- Push the counter gently back in the cover.

NOTE: Be sure that the screen shielding on the front make contact to the cover.

- Turn it upside down
- Install the two screws **(A)** at the bottom.
- Install the two rear feet with the screws **(B)** to the rear panel.

Fan

- Disconnect the power cable.
- Remove the cover from the counter.
- Remove the two screws **(A)** and nuts **(B)** from the fan.
- Disconnect the fan cable from J18.
- When reinstalling the fan, be sure that the air-flow arrow on the fan points to the rear of the counter and that the black wire is oriented toward the power module.

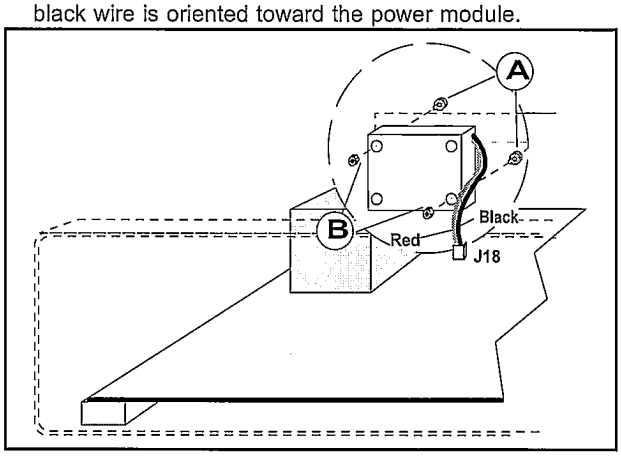

Figure 3-4 *The fan is fastened with four screws and nuts.*

PM 9621, PM 9624 or PM 9625 HF Input

- Disconnect the power cable.
- Remove the cover from the counter.
- Disconnect the cable from the mini-coax connector **(A)** on the HF input.
- Press the clips **(B)** apart and lift the HF input pca straight up and out.
- When installing the HF input, make sure that the connector pins fit exactly in the holes in the connector housing **(C)**.

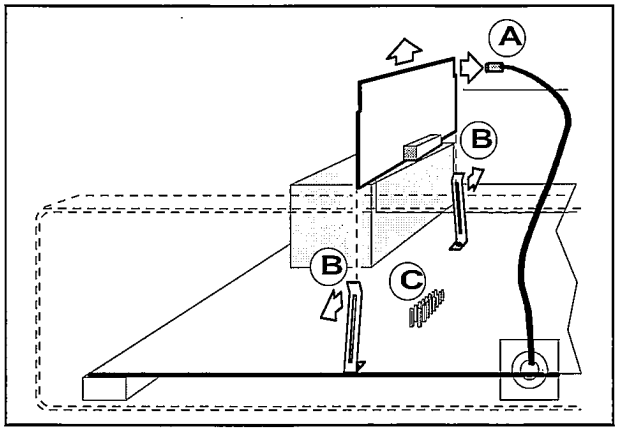

Figure 3-5 *Removing the HF input.*

PM 9678B TCXO

- Disconnect the power cable.
- Remove the cover of the counter.
- Remove the screw **(A)** holding the TCXO to the main pca from beneath.
- Lift the TCXO straight up.
- Make sure that the jumpers J12 and J15 are set in the correct position.
- When installing the TCXO, make sure that the connector pins fit exactly in the holes in the connector housing.

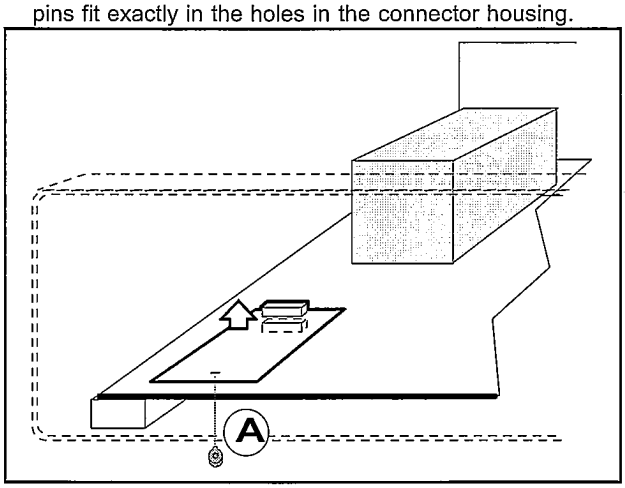

Figure 3-6 *Lift the TCXO straight up after removing the fastening screw.*

PM 9690 or PM 9691 Oven Oscillator

- Disconnect the power cable.
- Remove the cover of the counter.
- Remove the screw **(A)** holding the oscillator to the main pca from beneath.
- Press the clip **(B)** gently to the front of the counter and lift the oscillator straight up.
- Make sure that the jumpers J12 and J15 are set in the correct position.
- When fitting the oscillator, make sure that the connector pins fit exactly in the holes in the connector housing.

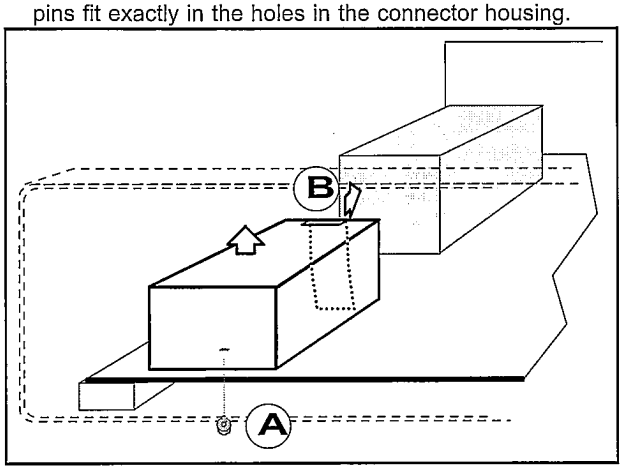

Figure 3-7 *A clip and a screw hold the oven oscillators in place.*

Reinstalling the Battery

The instrument will lose its stored programs and front panel settings when the battery is replaced if not connected to the line power.

WARNING: Disposal of lithium batteries requires special attention. Do not expose the batteries to heat or put them under extensive pressure. These measures may cause the batteries to explode.

Return used batteries to your supplier or to your local Fluke organization.

Exchange Procedure

- Remove the cover of the counter.
- connect the counter to the line power but keep it switched off.
- Lift the metal clip and press the battery towards the front of the counter using a screwdriver.

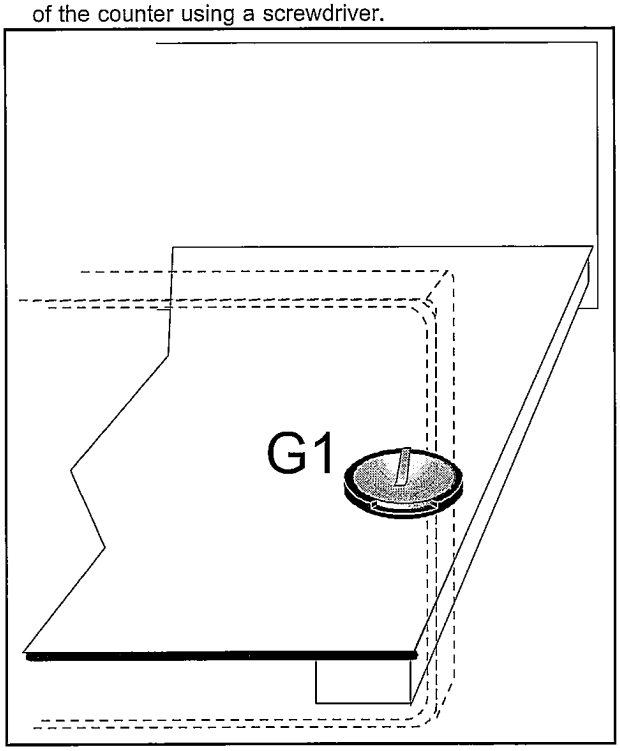

Figure 3-8 *Location of battery G1.*

- Clean the battery connectors with a cotton swab and alcohol.

NOTE: Do not touch the new battery with your hands to avoid self discharging.

- Insert a new battery between the metal clip and the plastic holder. You will find the ordering number in the Replacements Parts Chapter.
- Disconnect the power cable.
- Reinstall the cover to the counter.

Don't throw batteries in your wastebasket. Return used batteries to your supplier.

Chapter 4

Circuit Descriptions

Block Diagram Description

General

The PM 6681 Timer/Counter consists of three main units:
- Front unit
- Main board unit
- Rear panel unit

Several options can be added, these are:
- Prescalers (1.3 GHz PM 9621, 2.7 GHz PM 9624, 4.2 GHz PM 9625B, and 4.5 GHz PM 9625)
- Oscillators (TCXO PM 9678B and oven oscillators' PM 9690 and PM 9691)
- Rack mount adapter (PM 9622)
- Rear panel inputs (PM 9611/81)

The chassis of the counter consists of a front piece molded in aluminum, an aluminum rear panel, and three aluminum profiles that hold the front and rear panels together. This unit can be slid into the aluminum cover of the instrument.

The front unit contains all functions needed for the user communication. A flat cable connects the front unit to the main board unit, and the molded front-piece screws onto the two aluminum profiles.

Most functions, such as the following, are placed on the main board:
- Input amplifiers with trigger level circuits
- Power supply
- Measurement logic
- Microcomputer circuitry
- GPIB-bus
- Analog output
- External reference input
- External arming input

Some outputs, such as the TRIGGER LEVEL and PROBE COMPENSATION VIEW outputs are directly mounted on the main board.

The rear panel unit is an aluminum panel with a number of mounted connectors. Most of the connectors are soldered directly to the main board. The rear panel screws onto the two aluminum profiles.

NOTE: Simplified extractions from the Schematic diagrams are used in this chapter. For complete information, see Chapter 8, Schematic Diagrams.

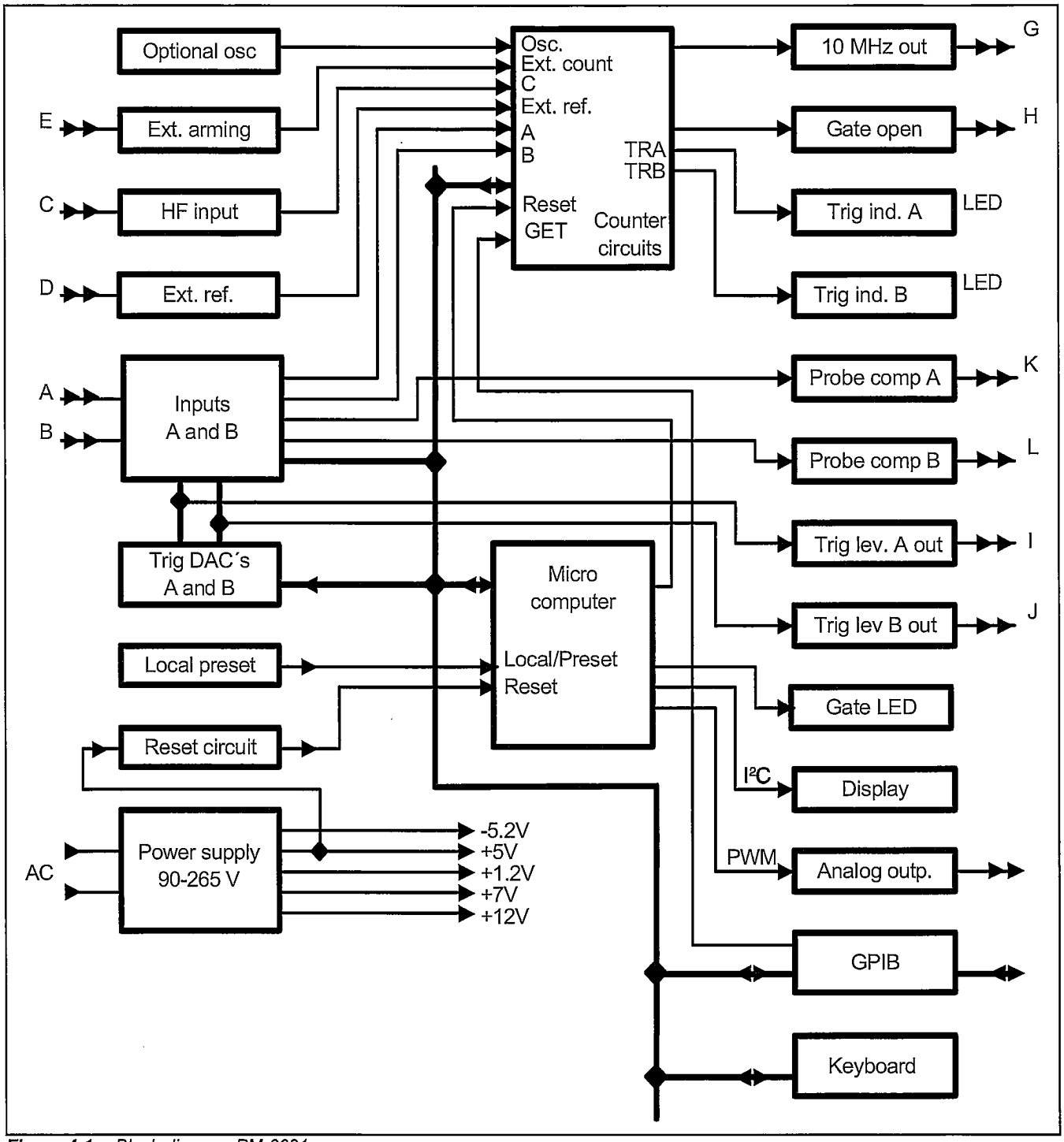

Figure 4-1 *Block diagram PM 6681.*

Hardware Functional Description

Front Unit

LCD Drivers

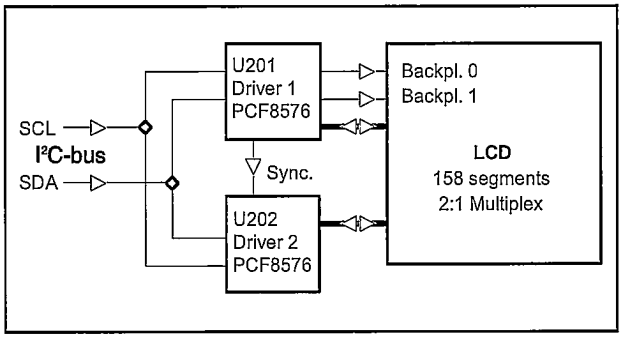

Figure 4-2 *Front panel LCD drivers.*

The front unit is made of a molded aluminum front. The keypad is made of silicon rubber with screened carbon pads on a PC board that covers the total front. An LCD and four LED's are used as indicators. To show both the measurement result and the state indicators of the instrument setting a LCD is used. The LED's shows standby, gating, and triggering channel A and B.

It has 160 segments that are multiplexed with a ratio of 2:1. Two cascade coupled LCD drivers (U201 and U202) are used. A serial I^2C bus connects the drivers to the µ-controller on the main board. R201 sets the clock frequency of the drivers to approximately 140 kHz. The VLCD pin is connected to GND on the main board.

A back-light is provided with the LCD. This is an LED array integrated to one component. It uses approximately 0.35 A and dissipates approximately 1.5 W.

Keyboard

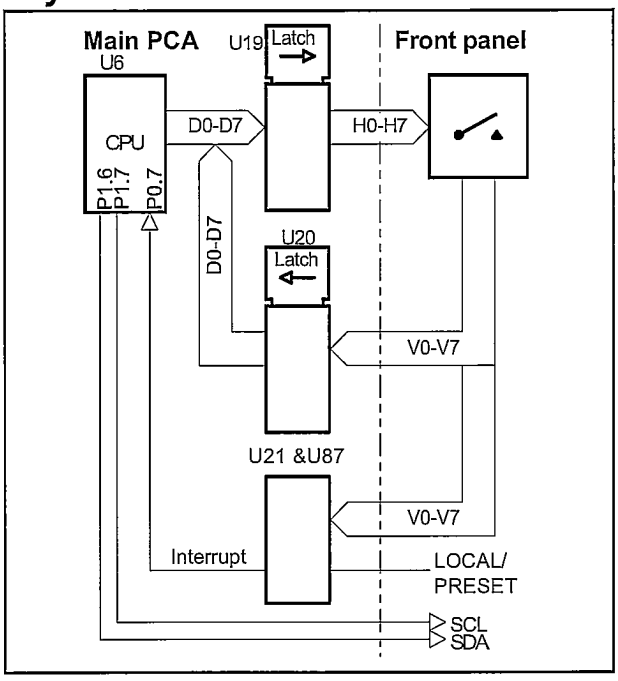

Figure 4-22 *Keyboard scanning.*

The push buttons are connected in a matrix and the scanning signals H0 to H7 are coming from the main board. If a button is pressed and H0 to H7 is high, one of the output signals V0 to V7 will be high. V0 to V7 are also connected to an interrupt input, P0.7 on the µ-controller U6 via the AND gates U21 and U87. The LOCAL-PRESET button is not part of the scanning, but connected directly to the AND gates U21 and U87.

Three screws fix the front unit to the main board unit. A 40-pin flat cable electrical connects the front unit to the main board.

Main Board

Input Amplifier A

Input amplifiers A and B are two matched 300 MHz amplifier circuits: Channel A and channel B.

Channels A and B are identical except the 100-kHz filter in channel A, the switching circuitry for the separate/common modes, the B-channel delay line, and event delay output. The following description refers to channel A but is also valid for channel B, (see Figure 4-4).

Four main stages makes the input amplifier: Input stage, impedance converter stage, comparator stage and buffer stage.

• *Input Stage*

The input stage contains:

- 50 Ω/1 MΩ impedance selector
- 1X/10X attenuator
- AC/DC coupling
- Voltage limiter

50 Ω/1 MΩ impedance selector

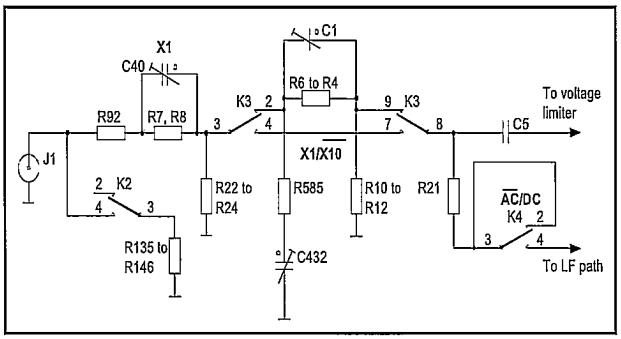

Figure 4-3 *Impedance selector, 1X/10X attenuator and AC/DC coupling.*

Relay K2A select 50 Ω or 1 MΩ impedance mode. 50 Ω is selected via resistors R135 to R146 if the relay switch is closed. 1 MΩ is selected if the switch is open, (see Figure 4-3). Depending on selected attenuation, the 1 MΩ input impedance is determined by different combination of resistors. Resistor network R7, R8, R22 to R24, and R92 determents the 1X attenuation. Together with 1X resistors R4 to R6 and R10 to R12 sets the impedance in 10X attenuation. The input capacitance in parallel with 1 MΩ is 15 pF. Resistor R92 immediately after the selector serves both as current limiter with the voltage limiter (see below) and as impedance matching resistor. This resistor also improves the V Standing Wave Ratio of the amplifier.

1X/10X attenuator

The 1X attenuator consists of the resistive low frequency divider, which reduces the input signal by a factor of 2.3. R7, R8, R22 to R24, and R92 forms the attenuator, (see Figure 4-3). The variable capacitor C40 and the parasitic capacitance forms the capacitive high frequency divider in parallel with R22 to R24.

Variable capacitor C40 adjusts the capacitive attenuator to the same attenuation as the resistive.

Resistors R4 to R6 and R10 to R12 forms the 10X attenuator. The variable capacitor C1 and the resistors R10 to R12 forms the capacitive divider. The parasitic capacitance is in parallel with resistor R10 to R12.

C432 set the 10X input capacitance equal to the 1X input capacitance.

AC/DC coupling

Relay K4A select AC/DC - coupling. In AC coupling relay K4A is open and the signal is fed through the AC capacitor C5, (see Figure 4-3). In DC coupling the relay K4A is closed and the AC capacitor C5 is short-circuited. To protect the relay contact the two resistors R20 and R21 serve as current limiters.

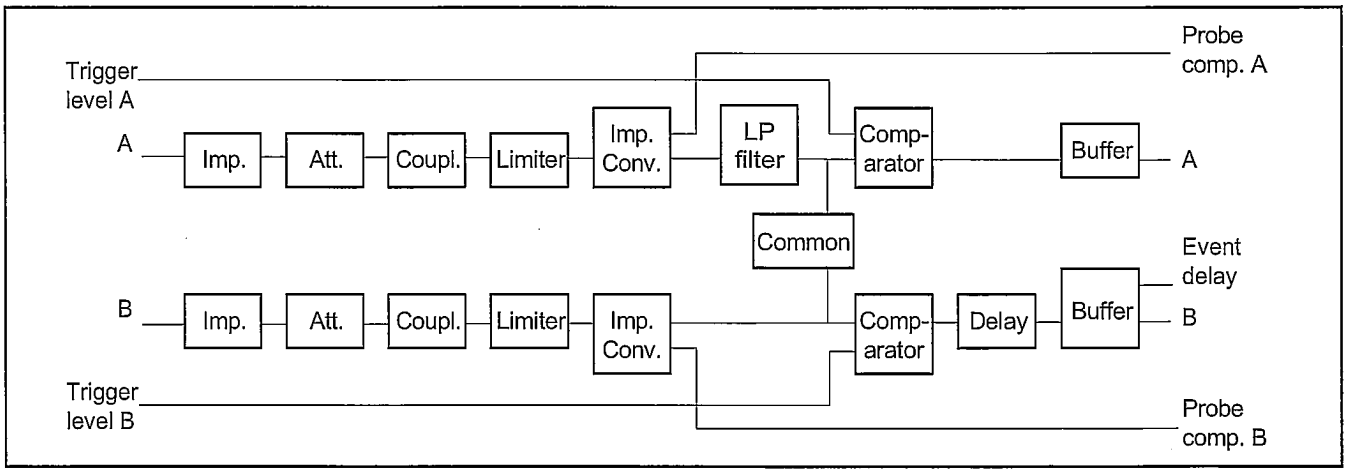

Figure 4-4 *Input amplifier block diagram.*

Voltage limiter

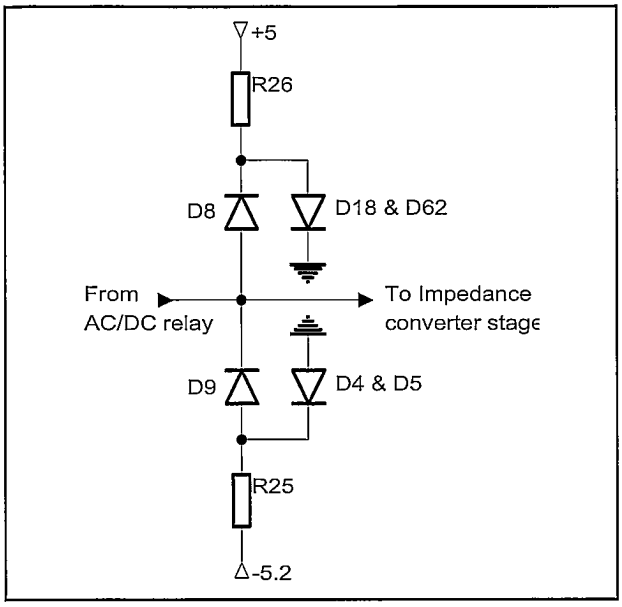

Figure 4-5 *Voltage limiter.*

A voltage limiter that protects the impedance converter against over voltage is placed between the AC/DC selector and the impedance converter, (see Figure 4-5). It consists of resistor R26, the diodes D18, D62, and D8 to clamp positive voltage. Resistor R25 plus the diodes D4, D5, and D9 to clamp negative voltage. The clamp voltage is approximately 2.7 V at low frequency signals. At high frequency the clamp voltage rises to approximately 3.0 V.

• *Impedance Converter Stage*

The analog signal from the input stage is fed to an amplifier stage where split-band technique is used to get a good frequency response over a wide range, (see Figure 4-6). This means that the high frequency path of the signal is fed via a high impedance AC-coupled FET transistor stage. In parallel via a DC coupled feedback operational amplifier stage, the low frequency path is fed. The low frequency path handles frequencies up to approximately 5 kHz.

Through the FET, V1 gate the high frequency signal is fed. The high impedance at the gate is converted to a low impedance at the source. Common for both high frequency and low frequency path the source is connects to the HF-transistor V25.

To make the FET work well in its active region within the whole dynamic range, the FET-drain is supplied with +12 V via resistor R94.

Two resistors, R16 and R17 divides the low frequency signal before it is coupled to the input pin 2 of the operational amplifier U1. Resistors R14 and R15 at U1 pin 6, center the output swing, and capacitor C3 stabilizes the operational amplifier stage.

The low frequency path goes via the operational amplifier, the base and collector of the transistor V25. This point (collector of V25) is the common point for the high and low frequency paths of the input frequency.

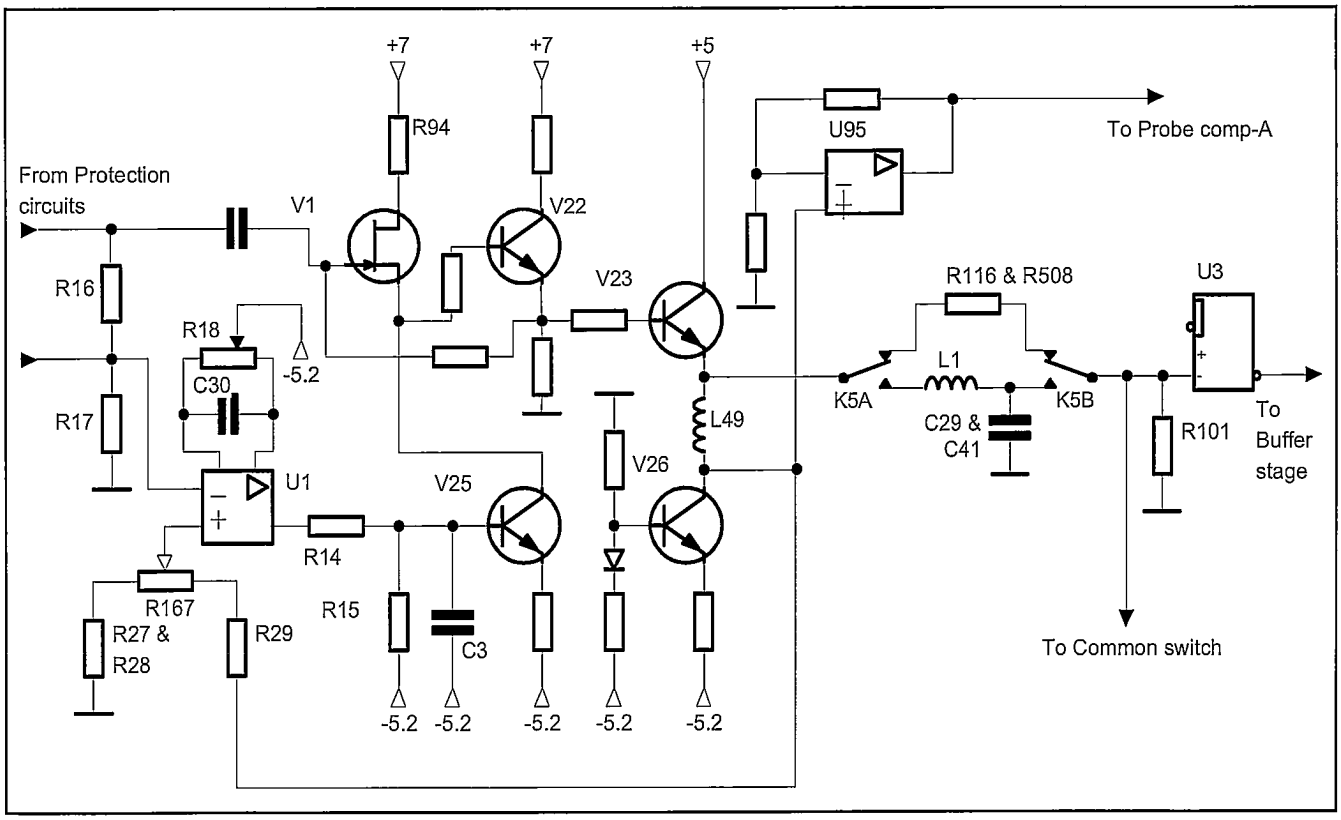

Figure 4-6 *Impedance converter.*

A driver stage (V22), an output stage (V23), and a current generator (V26), forms an amplifier with high output current. This amplifier is used to get a linear output in the 100Ω load resistor R101 over a swing of 2 V.

From the output of this second amplifier stage, the signal goes back to the operational amplifier pin 3 via divider R27 to R29 and R167. Trim potentiometer R167 sets the gain of the low frequency path equal to the high frequency gain, (about 0.9). Capacitor C30 is connected to U1 pin 1 and 8 to achieve stable operation. The trim potentiometer R18 between pin 1 and 5 on U1 is used to adjust the offset voltage of the operational amplifier.

The channel A filter connected to the output of the second amplifier stage is a 100 kHz LC-filter. It consists of coil L1, and two capacitors, C29 and C41 in parallel. Two relay-contacts, K5A and K5B, controls the filter. The filter output is connected to the input of the comparator stage.

The output of the amplifier stage is also connected to the rear panel via the amplifier U95. By using this output called "PROBE COMPENSATION A" it is possible to compensate a probe connected to the counter. This voltage is also connected to an analog input in the µ-controller. This makes it possible for the µ-controller to get a quick knowledge about the input voltage.

• Comparator Stage

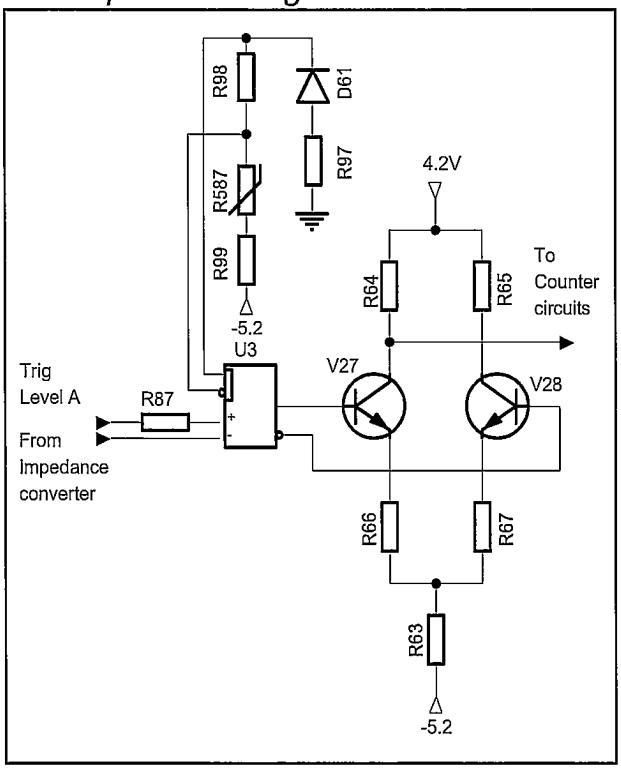

Figure 4-8 *Comparator and buffer stages.*

The comparator stage converts the analog signal from the impedance converter stage to a square wave, (see Figure 4-8). This circuit consists mainly of the high speed integrated comparator U3 and a separate trigger level circuit connected to the comparator at pin 8 via resistor R87.

A DC level in the range of approximately –2 V to +2 V are generated by the trigger level circuits, which are described later. This covers a dynamic range of 5 V since the input signal is divided by a factor of about 2.4 before it reaches the comparator.

The counter is provided with fixed hysteresis, i.e., it is not controllable via the front panel or GPIB.

• Buffer Stage

Before the signal is fed further into the ASIC OQ0502, U58 it has to be converted by the buffer stage, (see Figure 4-8). The negative ECL logic levels (~ –0.9 V to ~ –1.7 V) from U3 pins 2 and 3, are converted to a single-ended signal with positive ECL logic levels (~ 4.1 V to ~ 3.3 V).

The buffer is a differential amplifier consisting of the two transistors, V27 and V28 whose bases are fed differentially from the two comparator outputs. Resistor R63 sets the current in the stage. Resistors R66 and R67 serve as current limiters to stabilize the stage and the two collector resistors R64 and R65.

• Common B via A

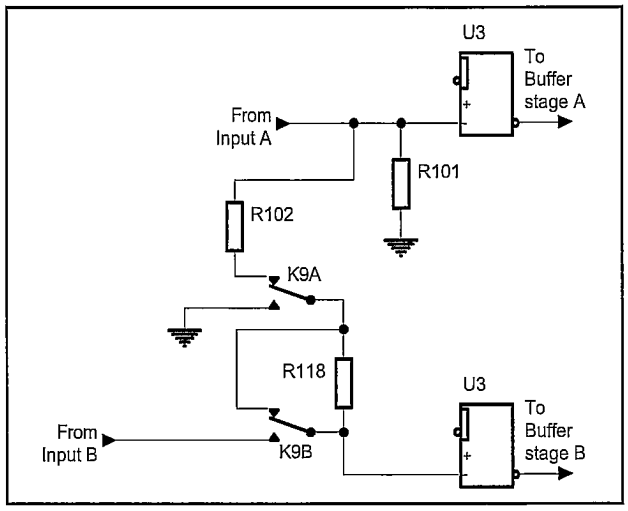

Figure 4-7 *Common B via A.*

The output signal from V23/ V26 can also be fed to the B-channel comparator, (see Figure 4-7). This is done in Common B via A mode. Relay K9A and K9B connects the comparator inputs pin 7 (A) and 10 (B) in parallel. Simultaneously relay K9B disconnects the output signal from input B to the B-channel comparator. In separate mode, the relays connect the output signal from input B to B-channel comparator input pin 10 (K9B), and disconnect the signal from input A to the B-channel comparator pin 10 (K9A).

The resistors R101 and R118 set the impedance in the comparator stage to 100 Ω.

Input Amplifier B

Input channel B is the same as input channel A with the following exceptions:

- The Common B via A switches, that connect the B-channel comparator to the input signal on channel A.
- The B-channel delay line.
- The B-channel has no lowpass filter.
- The B-channel has a special event-delay signal output to OQ0504, U56.

• Delay Line

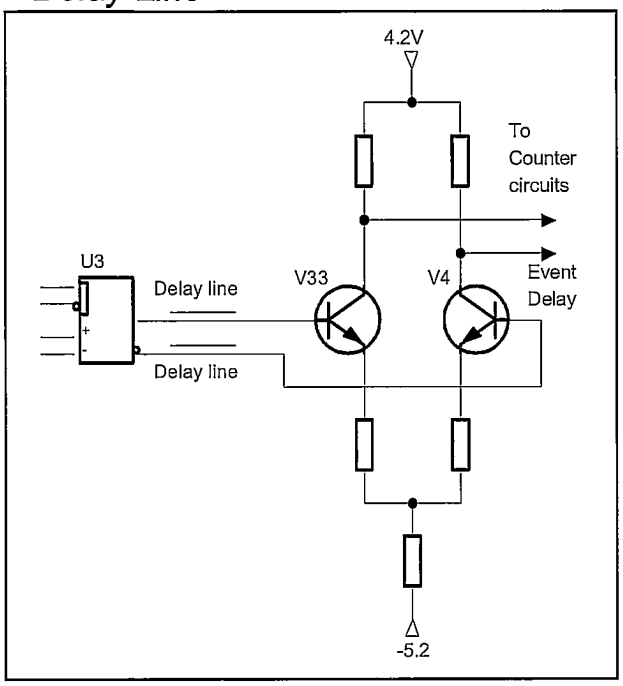

Figure 4-9 *Delay lines.*

A line of approximately 65 cm is placed between the "B-channel comparator output" pins 15 and 16 and the buffer stage V33 and V4, (see Figure 4-9). This delay line is a part of the circuit board. It should compensate for delays in OQ0502, U58.

• Event Delay

Also for use in the arming function, the inverse output from the buffer stage V4 of channel B is used, (see Figure 4-10). This signal called EVENT-DELAY, is connected to the OQ0504 circuit U56 via the transistor V12 and the IC, U47 which works as a multiplexer.

The EVENT-DELAY signal is also used by the HOLD-OFF logic when the input pulses should be counted, (see Counter circuits on page 11).

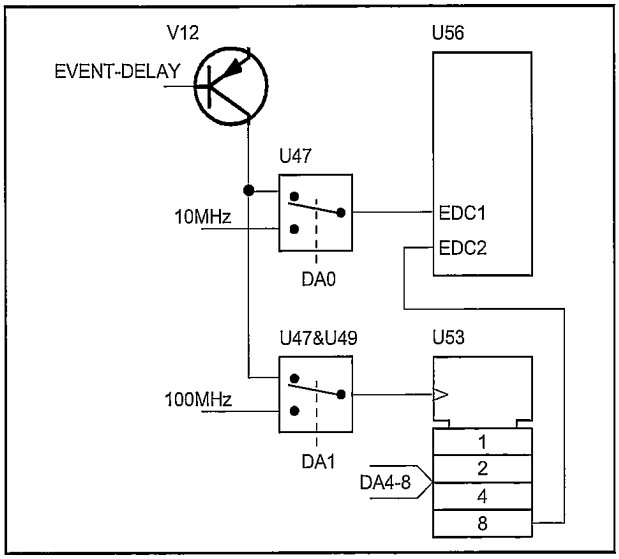

Figure 4-10 *Event delay.*

Calibration Circuits

U93 and a delay line on the PCA generates a xx ns long pulse, and feed it to channel B input on the counter IC, U56. This pulse is initiated by the µ-controller pulse CAL-TEST-PULSE.

Trigger Level Circuits

The trigger level circuits generate the trigger levels to the A and B inputs. The trigger level range is –5.1 V to + 5.1 V with a resolution of 1.25 mV. As the input amplifier attenuation is approximately about 2.4 times, the trigger level circuits generate a DC level that has the same attenuation. This means that the output of this circuit has a range of –2.2 V to +2.2 V with a resolution of 0.5 mV. To get the high resolution, two 12-bit DACs are used. The supply voltages to the trigger level circuits are filtered to prevent noise from the digital circuitry to influence the trigger level, (see Figure 4-11).

The trigger level circuits consists of:

- Reference voltage circuit (2.5 V), (U86).
- Reference voltage inverter circuit (–2.5 V), (U59).
- A multiplexer to select positive or negative reference voltage and Full scale B or Full scale common B trimmers, (U60).
- Buffer circuits, (U61 and U62).
- Two Digital to Analog converters, (U63 and U64).
- Two current-to-voltage converters (U65 and U66). These circuits convert the current at the IOUT pins of the DACs to a voltage. This signal has a range of approximately –2.1 V to 2.1 V.
- Two output buffers and RC filters for the trigger level outputs on the rear panel. (U67).

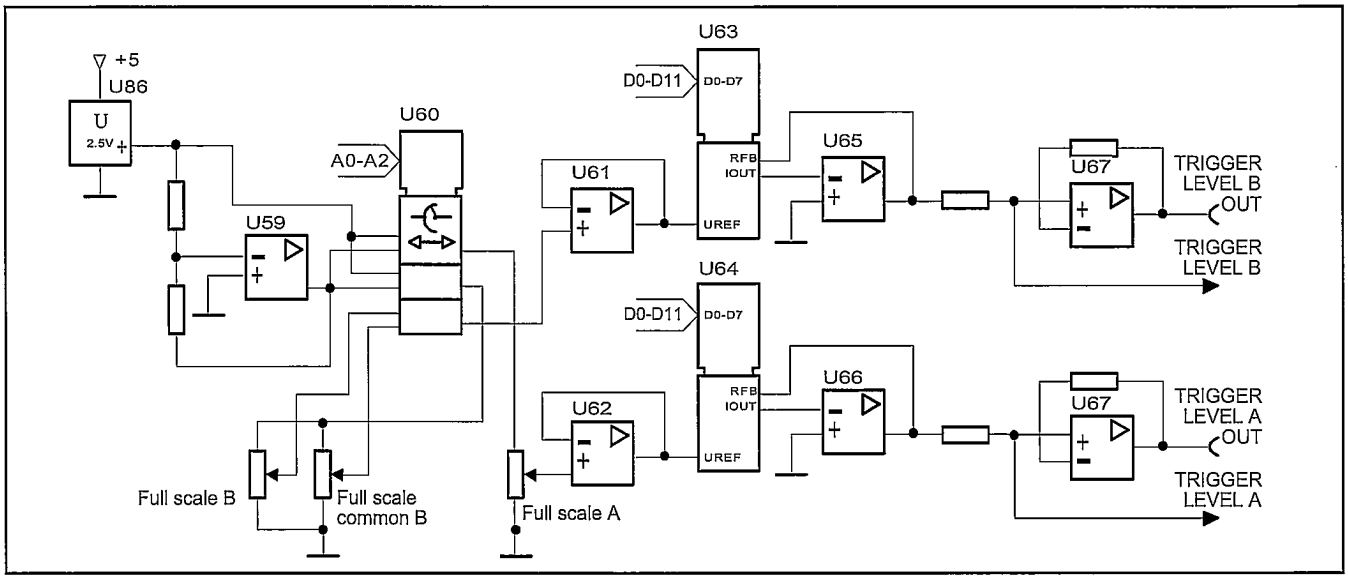

Figure 4-11 *Trigger level circuits.*

Power Supply

• Primary Circuits

The power supply generates five regulated DC supply voltages to the counter. It also generates some other supply voltages for special purposes. The power supply block also contains the ON/STANDBY logic, (see Figure 4-12).

The main building-block of the power supply is the primary switch mode power circuits. A rectifier make a DC-voltage of the line power AC-voltage (90 V to 265 V), before it is fed to the switch circuits.

After a line-power filter in the power inlet, a fuse and an NTC-resistor protect the power supply. The fuse (F1) should only blow if a catastrophic error occurs on the primary side of the power supply. A short-circuit on the secondary side should not affect the primary side. To minimize the "current rush" to the capacitors at the connection of the power cord, an NTC-resistor (R337) is used. The resistance is 16Ω when the resistor is cold, but decrease to a few ohms when warmed up by the current. The AC voltage is rectified in the bridge rectifier D40 and filtered in C330. C181, C183, and C184 should suppress noise from D40. L20, C173, and C174 forms filters.

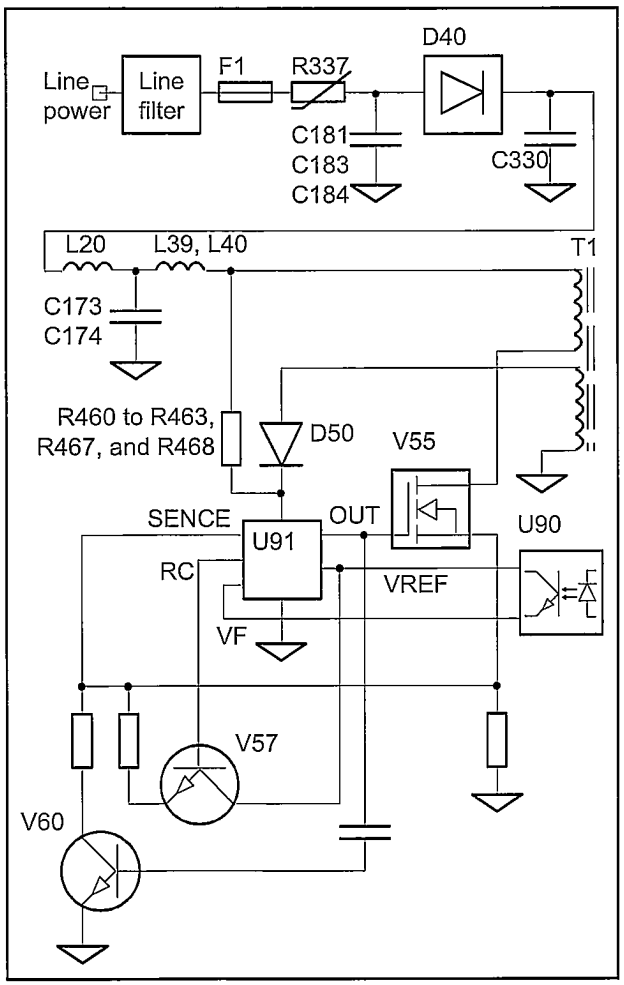

Figure 4-12 *Power supply, primary circuits.*

L39 and L40 prevent HF-noise from the switch circuitry to reach the line-power inlet.

R460 to R463, R467, and R468 gives the start up voltage to the control circuitry U91. U91 outputs a frequency of 120 kHz on OUT (pin 10) to the switch transistor V55. When the switch transistor has started U91 will be supplied from the transformer T1 pin 3 via the diodes D50A and D50B.

Every switch pulse causes a voltage drop over the resistors R471 to R473 and R558. This voltage feeds the SENSE input (pin 5) of the control circuit U91. When the voltage has reached the internal reference level in U91, the switch transistor V55 is turned off.

V60 is a blanking transistor that will compensate for high transients generated by the transformer T1.

The internal sawtooth generator RC (pin 7) in U91 is connected to the SENSE input via V57, to compensate for low load.

The regulated +5 V is senced by U92 and adjusted by R446. The output of U92 is connected to the VF input (pin 3) of U91 via the opto coupler U90.

The VREF pin (pin 14) outputs a reference voltage of 5 V DC.

• Secondary Circuits

A voltage over the capacitor C373 is generated by the diodes D56A and D56B. This voltage is used to generate a power-failure interrupt, (NMI) to the µ-controller, when the line-power disappears, (see Figure 4-13).

From the module there are three DC voltages outputs. One of those is regulated (+5 V) and the others are unregulated. These voltages will vary with input line voltage, the current at +5 V, and at the unregulated voltages. The output, marked +15, will be 14.8 V to 21 V and the output ,marked –9, will be –12.5 V to –7.5 V. The outputs are filtered, HF-filtered by C176, C177, and C178 and LF-filtered by L19, L21, L22, C179, C329, and C333.

These three DC voltages are used to make the following five supply voltages in the counter:

+5 V

From the switch transformer T1 via D43 and regulated by V49 and U72..

–5.2 V

–9 V is regulated by V17, U73, and U74.

+12 VREG

+15 V is regulated to +12 V by U69.

+12 VREG is used for the optional oven oscillator and the STAND-BY indicator.

+12 V

+12REG V is swithed on and off by +5 V via V18 and V48.

+7 V

U70 and U71 regulates +12 V to be +7 V.

The voltages for special purposes are:

+9 V

Used unregulated.

At stand-by, the regulated supply voltages except +12VREG are switched off. However some special voltages are not, because the oven oscillator should be on and the ON/STANDBY logic should function, therefore, the primary power circuits will never be switched off. PM 6681 has only a secondary power switch.

A relay (K1C) disconnects the load of the +5 V and –5.2 V at stand-by. Because the power circuits always must have a load on the regulated voltage, a bleeder resistor R349 is always connected to +5 V. At standby the counter only needs +12 V, and to get enough current of this voltage, a certain current of the regulated +5 V must be used.

+5 V controls the switching on/off of +12 V and +7 V. When +5 V is on, V48 conducts, and the base of V18 will be approximately +11 V and the transistor will conduct, i.e., +12 V will be on. If there is no +5 V, V48 will be off, and the base of V18 will be +12 V, thus blocking the +12 V.

The ON/STANDBY logic controls relay K1A, which operates as described above. J15 have three functions:

Normal	K1A controlled by the ON/STANDBY logic.
Removed	K1A allways open.
Ground	K1A allways closed.

Fan

The temperature is senced by counter circuit U58 which outputs an analog signal to the µ-controller U6. The µ-controller also senses the temperature on the main PCA via

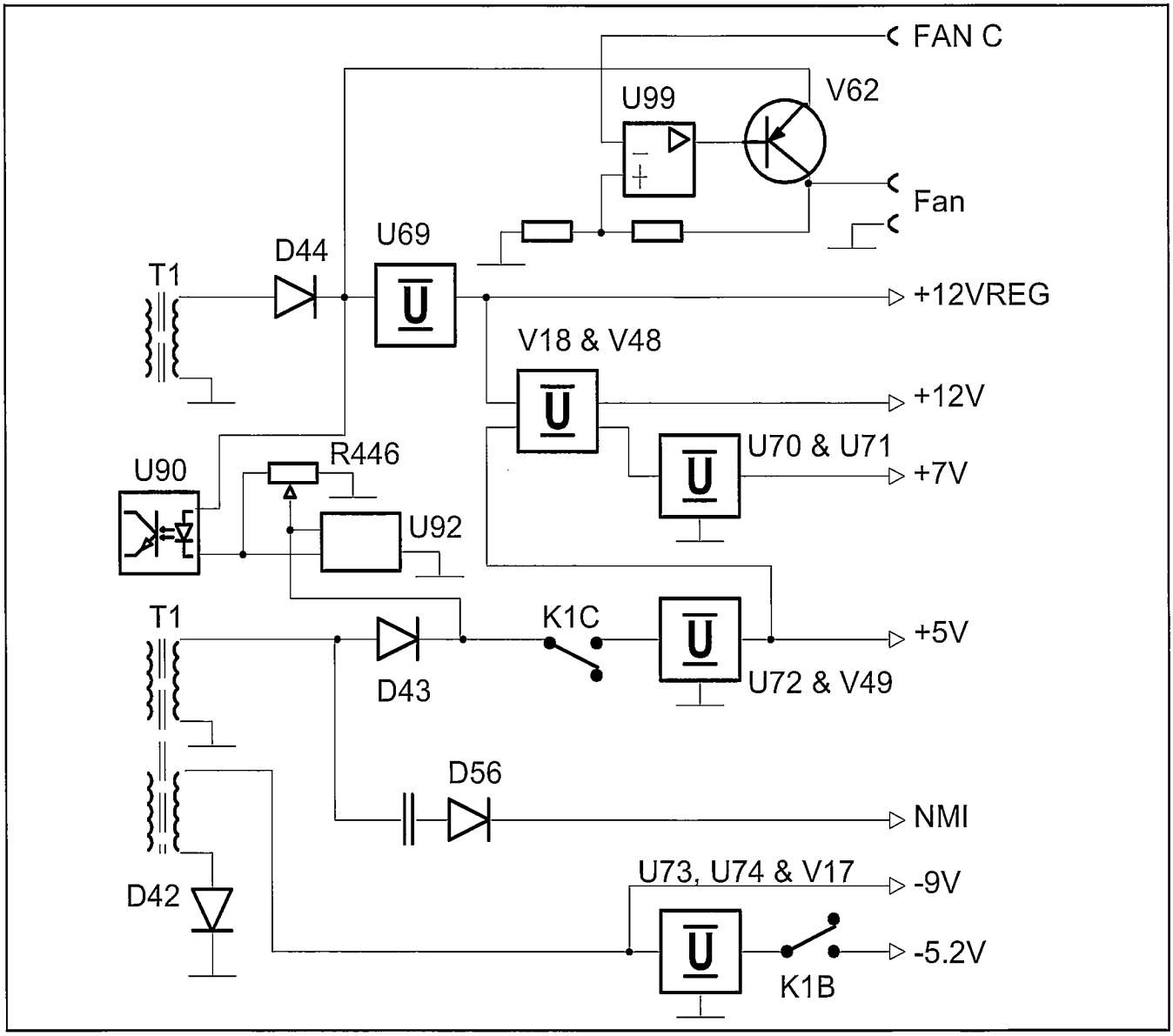

Figure 4-13 *Power supply.*

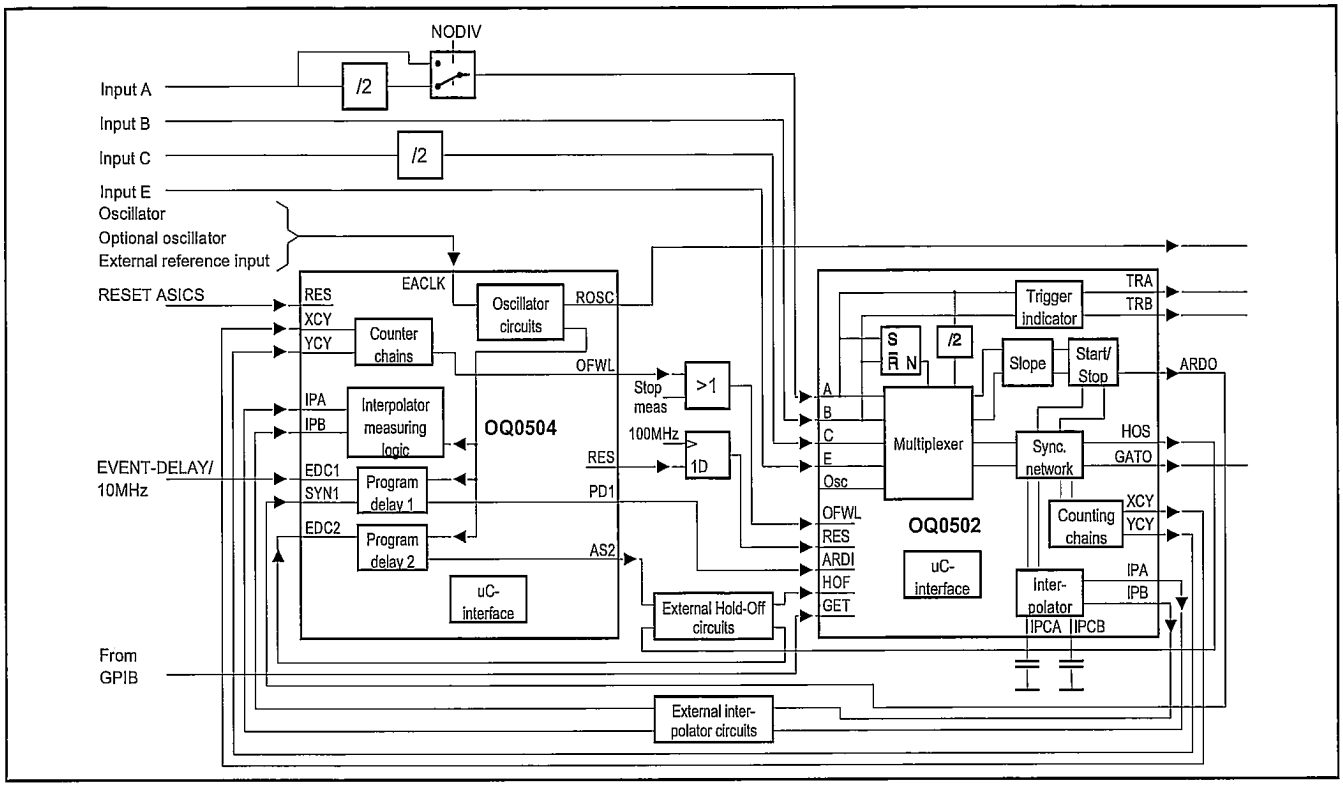

Figure 4-14 *OQ0502 and OQ0504 block diagram.*

the resistor R564 and then controls the fan via U99 and V62.

Counter Circuits

The PM 6681 measuring logic consists of two ASIC's: One high speed bipolar ECL circuit and one CMOS circuit. The bipolar SMTC, (U56) contains the measuring control functions, high speed counters and some analog parts used to increase the time resolution. The CMOS ASMTC, (U58) consists of two counter chains for the measurement and logic for measuring the expanded interpolator pulses. It also contains two programmable mono flip flops (100 ns resolution), an oscillator and an external reference input, (see Figure 4-16).

Interpolator

The bipolar circuit has a small analog part. This part increases the resolution in time and frequency measurements by means of an analog interpolator. An analog interpolator is basically a capacitor charged and discharged with different currents (ratio approximately 400). A small error pulse is extended with the ratio of these currents, (see Figure 4-14).

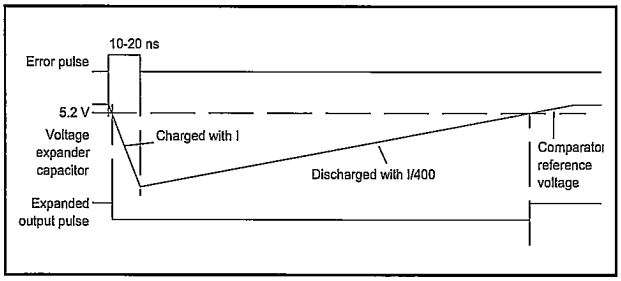

Figure 4-16 *The interpolator expands the error pulse 400 times.*

Using the standard clock frequency as a reference we can measure this new extended pulse length. There are two interpolators, one start and one stop interpolator. OQ0502, (U58) circuit includes the generation of the error pulse and the time expander. OQ0504, (U56) holds the measuring logic for the expanded pulse. The small error pulse is the time from the external trigger event to the second positive clock transition. Consequently, the error pulse is between 10 ns and 20 ns long. The extended pulse is approximately 3 to 7 µs, (see Figure 4-15).

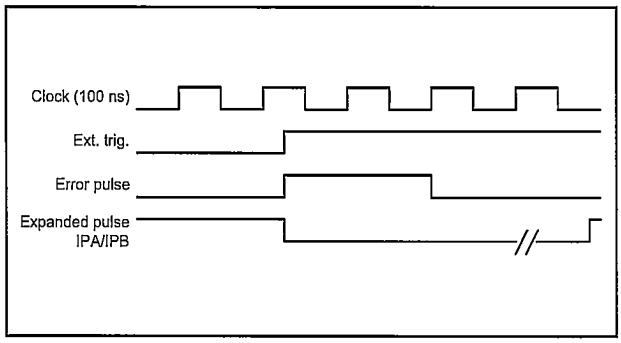

Figure 4-17 *Measuring the expanded pulse in the OQ0504 and the external counter.*

Very fast events can not be handled by the counter circuits. Therefor some external interpolator circuits have been added to the interpolator circuits located inside OQ0502, U58. The counter circuits, U39 and U41 are clocked with 100 MHz when the signals IPA and IPB are present. After the counter circuit the signal is fed to OQ0504, U56, to be measured.

Timing

The following timing diagram (Figure 4-17) shows a number of measurement signals for a frequency measurement of 11 periods. This measurement is started directly when reset is released. The measurement start can be controlled in a much more detailed manner. GET and arming delays (event or time) can be used to qualify the measurement start. Qualifying the stop can be done in the same advanced way. The basic method is to send a Measurement STOp (MSTO) signal to the circuits via the µC interface. This signal cannot be viewed externally.

The length of IPA and IPB is not correctly viewed (approximately 3 to 7 s).

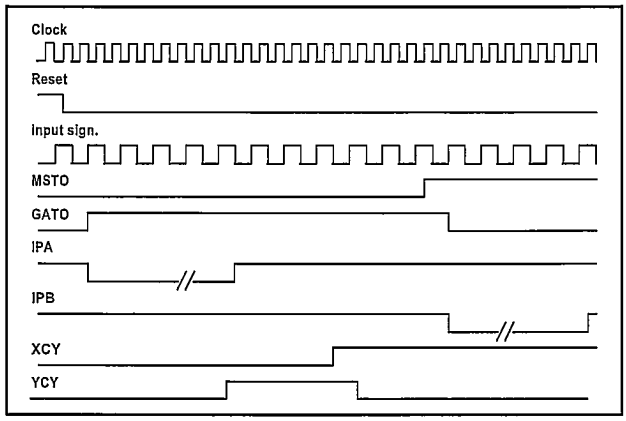

Figure 4-15 *A number of measurement signals for a frequency measurements of 11 periods.*

XCY (X carry) is the input signal divided by 8. YCY (Y carry) is the clock divided by 8 (12.5 MHz). These two signals will normally look like a burst signal of 12.5 MHz and the input signal divided by 8. The burst length is as long as the gate time. An OverFLow Warning message, OFLW is send to the OQ0502 circuit. This means that the counter chains in OQ0504 will soon overflow and that the start/stop logic should stop the measurement when possible.

Reset

The RESET signal is coupled as a ripple through chain. By this method the reset signal resets the whole measuring logic in a correct order. The reset chain starts at the RESET IN pin on OQ0504, ripples through the measuring logic of OQ0504 and comes out on RESET OUT. The RESET signal is clocked through a flip-flop by the 100MHz signal and is then connected to the RESET IN pin of OQ0502 and resets the measuring logic of OQ0502.

The TRA and TRB signals are directly controlling the trigger LED's on the front panel. C315 and C316 connected to TRAC and TRBC inputs control the blinking rate.

Arming Delay

The measuring logic also has a programmable delay with a resolution of 100 ns. This delay is used as arming delay and is generated in the OQ0504. It is triggered from OQ0502 by the signal ARDO (to SYN1 in OQ0504). Toget-

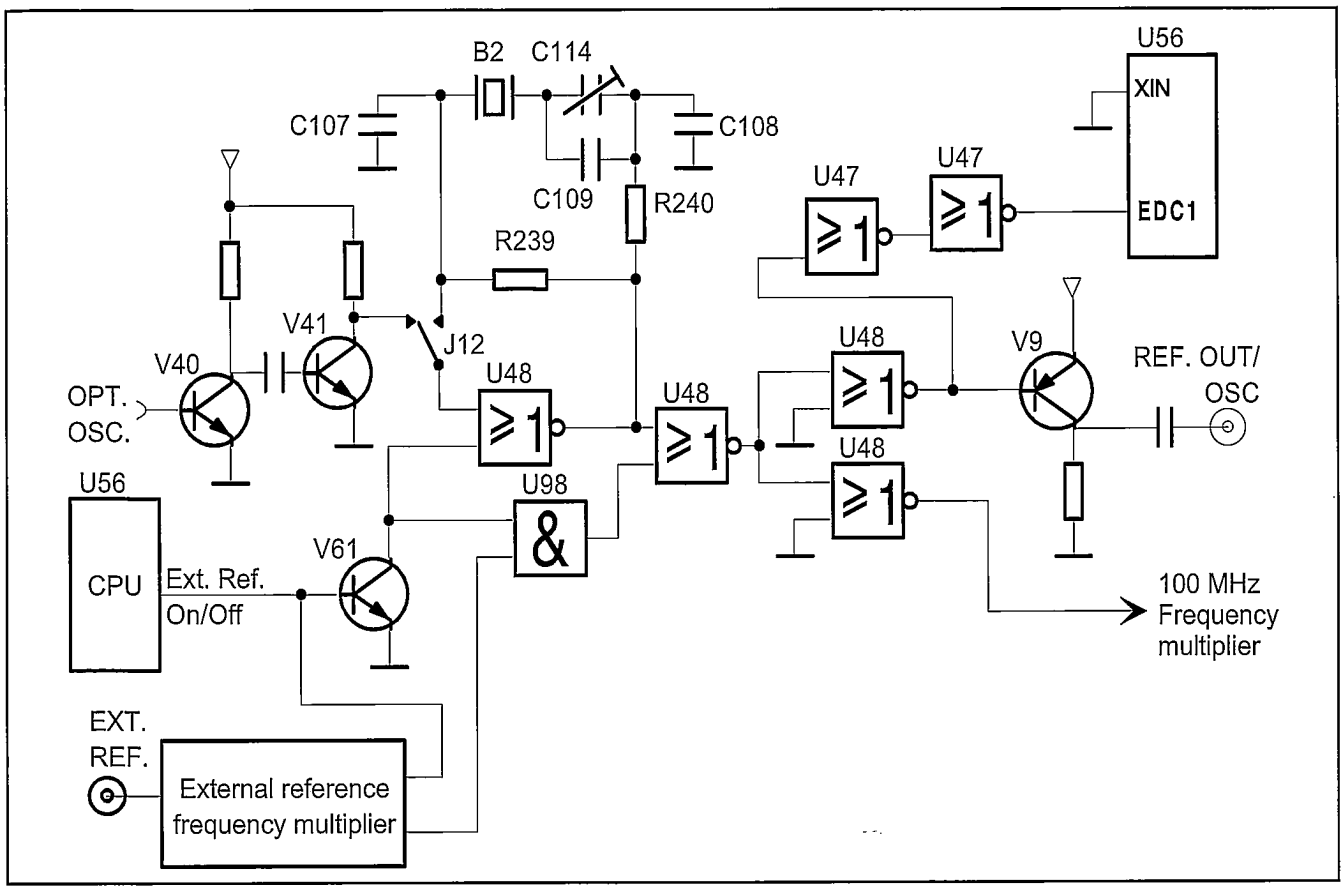

Figure 4-18 *Oscillator circuits functional description.*

her with the signal PD1 from OQ0504, the delayed signal is fed back to the ARDI input on OQ0502. Instead of a time delay, the delay can be programmed to an event delay. The EDC1 input of OQ0504 are therefore connected to the B input enabling, event delay for events on the B channel.

Hold-Off

A second programmable delay with a resolution of 10 ns is used as hold off. It is triggered from OQ0502 by the signal HOS. The counter U53 is loaded with a value and clocked with 100 MHz. When the counter has come to zero this information is sent to OQ0504, EDC2 and the circuits are reseted.

The delayed signal is fed back to the HOF input on OQ0502.

Gate Open

The signal GATO from OQ0502 gives a real time indication of the state of the measuring logic. Main gate open is indicated by a high level and main gate closed is indicated by a low level. V122 makes it possible to make the high level 1.4 V in 50Ω.

Divider

The signal from input A is divided by two during frequency A measurements by the divider U85. The reason for this is that the OQ0502 can not handle frequencies above 225 MHz.

To be able to measure frequency bursts also on input C the signal from the prescaler is divided by two by the other half of U85 before it enter the OQ0502..

Inputs

The signals A (A-channel), B (B-channel), C (prescaler signal), and E (rear panel external arming input) go to an input multiplexer in OQ0502. In OQ0502 the A and B inputs also have slope selections (positive edge and negative edge). R257 and C117 terminates the C signal.

External Arming

The rear panel input EXTERNAL ARMING is a DC-coupled TTL level input. R258 to R261 with D32 and D33 protects the input. V8 and V42 are a Schmitt-trigger with approximately 1.4 V threshold level. The external arming signal is connected to E input on OQ0502.

Burst

The signal HOS from OQ0502 are also used when measuring at bursts. The External Arming input is switched off by the signal HSO.4 from the µ-processor via V66 and V65. The HOS signal is then fed via V68 and V67 back to the OQ0502 input E.

All ECL-inputs in OQ0502 get their reference (VBB) from an external ECL-circuit U132.

The GET-signal from an optional GPIB-interface can control the start of the measurement.

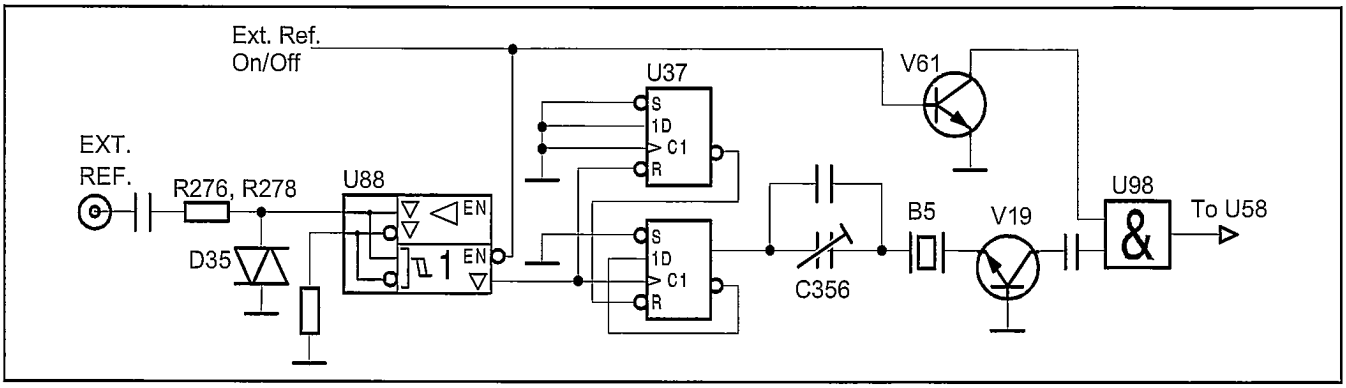

Figure 4-19 *External reference circuits.*

Oscillator Circuits

• CPU oscillator

The µ-controller U6 works with 16 MHz. A 16 MHz crystal B1 is connected to the XTAL inputs of the µ-controller. This frequency is divided by two by the µ-controller and is used by the GPIB controller U78.

• Standard oscillator

The 10 MHz reference oscillator is used as a reference for the measuring logic, (see Figure 4-18).

For the internal oscillator, there are several optional oscillators to choose from. The uncompensated 01-oscillator is always mounted in the PM 6681. If a better oscillator is needed, it should be connected to the opt.osc connector P105. A TCXO PM 9678B, oven oscillator PM 9690, or oven oscillator PM 9691 can be mounted. If this is done the oscillator type jumpers J12 should be placed in the OPT position.

The 01-oscillator consists of a crystal B2, C107 to C109, R239, R240, and the trim capacitor C114. C114 adjusts the frequency.

If an optional oscillator is mounted, the 10 MHz signal is amplified in a two stage amplifier (V40 and V41).

• External Reference Input

The external reference input can handle frequencies in steps from 1 MHz to 10 MHz, (1, 1.111, 1.25, 1.4285, 1.6667, 2, 2.5, 3.3333, 5, & 10 MHz).

R276, R278, and D35 protect the input. U88 amplifies the signal and make nice pulses out of it. U37 generates short pulses which is then filtered in the crystal filter B5 to be 10 MHz, (see Figure 4-19).

It is possible to switch off the external reference signal with the signal DISABL-EXT-REF from the micro controller. A low level of this signal makes V61 conductive, and that forces a high ECL-level on the output of U98.

The selected reference is used as 10 MHz out. An amplifier stage, V9 transforms the square wave from U56 to a sine signal. This stage has 50 Ω driving capabilities.

• 100 MHz Frequency Multiplier

The 10 MHz reference signal is fed to the flip-flops U81, which generates short negative pulses, (see Figure 4-20). These pulses triggers the resonant circuit, L25, C414, tuned to 100 MHz. After the amplifier V20, the signal is again fed to a resonant circuit, L29, C346, tuned to 100 MHz. A 100 MHz filter B3 removes over- and undertones. this procedure is repeated to get a nice sine wave. U94 generates a sqare wave signal which is used directly by the external Interpolator counter and Hold-off circuits. The 100 MHz sqare wave is also converted to ECL levels by resistors R238, R266, and R432, and used by OQ0502 as reference.

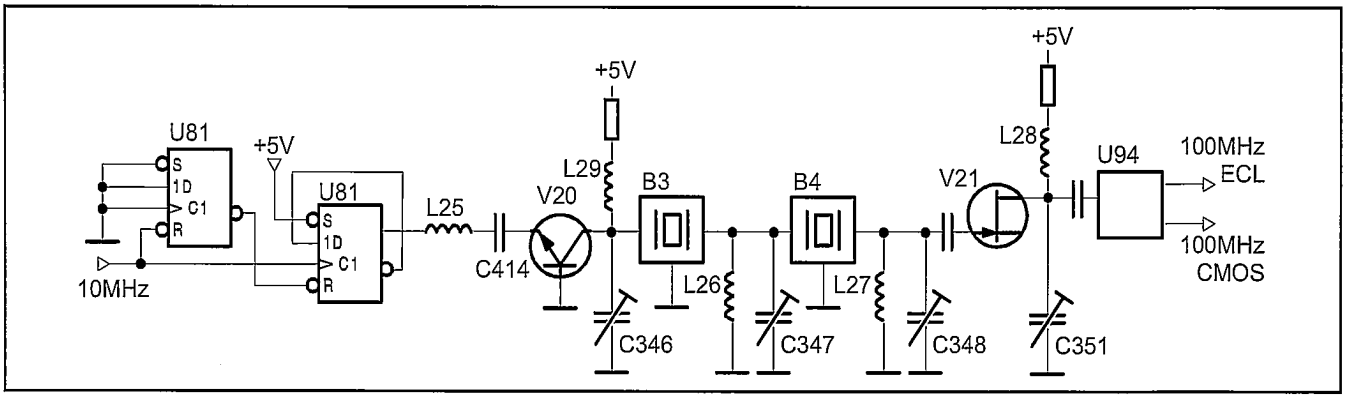

Figure 4-20 *100 MHz frequency multiplier.*

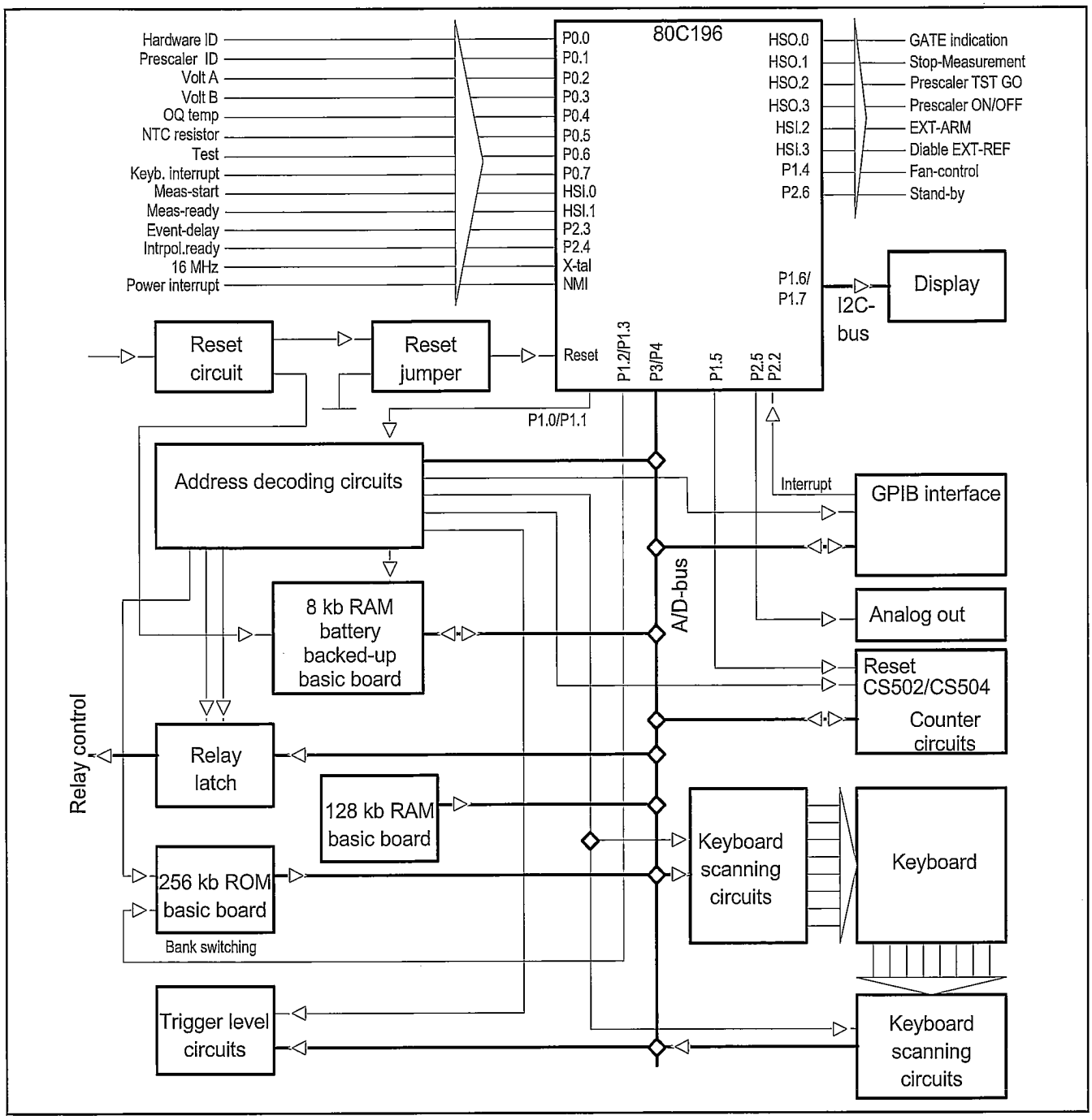

Figure 4-21 *Block diagram, PM 6681 logical circuits.*

Logical Circuits

• *Microcomputer Circuits including. I/O*

The microcomputer in PM 6681 is an Intel 16-bit CHMOS µcontroller 80C196KC16, U6. It is a fast micro controller, intended for controller applications, i.e., it has many I/O ports and other facilities to control and react on the external world. It contains 232 RAM-bytes, (see Figure 4-21).

The micro controller can operate in both 8 and 16-bits mode externally. Internally the micro controller uses 16-bits. The address and data-bus AD0 to AD15 is shared (time multiplexed) between addresses and data. Therefore the address must be stored in an address-latch (U14 and U15) by using the signal ALE (pin 62).

If the surrounding circuits are slow compared to the micro controller, wait states must be issued. The ready-pin (pin 43) goes low to get wait states. When the micro controller communicates with the battery RAM, the GPIB-chip, the ASIC;s, and the trigger level circuits, wait states are automatically inserted.

The PROM;s (U16 and U17) used is a 27H010, i.e., two 128K byte memories. The address mapping is done so we can only address 32K bytes directly. Bank switching is

used to be able to use all 128K bytes. The signal from U6 pin 21 and 22 controls that one quarter of the memory is used for the moment. At reset the first quarter is selected (U6 pin 21 and 22 goes high).

To be able to make a CRC-check of the contents of the PROM, the micro controller must be able to read the contents of the PROM as data.

The address and data bus AD0 to AD15 can be separated into two parts. By removing resistors R183 to R190, R209 to R212, and R221 to R224 you can separate the micro controller, the address latch and the PROM from all other circuits on the bus. By removing R225 to R232 you can separate the counter circuits and the GPIB controller from the AD-bus.

The micro controller communicates with the outer world by I/O circuits connected to the address and data bus AD0 - AD15. The WR (pin 40) and RD (pin 61) signals from U6 control the direction of information. These two signals, with the address decoding logic, produce "chip select" signals for the I/O circuits. The address decoding logic uses the A5 - A15 to produce chip select signals. Chip select signals are generated for:

- PROM, U16 and U17, and RAM, U9 to U13.
- The input amplifier relay driver U18, display scanning circuit U19 and U20, and the GPIB driver U78.
- The trigger level circuits U63, U64, and U60 and the counter circuits U56 and U58.

To show that the counter measures, a gate indicator is placed on the front panel. It is controlled from the micro controller U6 pin 28 via V54. The blinking of the LED is software controlled, and does not necessarily reflect the true state of the measuring hardware.

The RAM, U13 has battery backup. If the counter is ON or in STAND-BY, the +12VREG gives power to the RAM pin 28, via U7 and D30 to get +5 V. If the counter is not connected to the line power at all, the 3 V battery gives power to the RAM. The Schottky diode D31 isolates the battery and preserves power when +12VREG is present. When this happens pin 27 of the RAM is low, and the RAM goes to the power-down mode. At this point the RAM needs a 2 V supply voltage.

The version of the main PCA are identified by the resistors R524 and R525. This DC voltage are fed into the analog input ACH0 of the µ-controller U6, which recognizes the board. This makes it possible to make the software backward compatible.

The different prescalers are identified in a similar way. R192 to R194 and R203 to R204 forms a resistor network that generates different DC voltages at the ACH1 input of the µ-controller. This DC voltage depends of how the pins 12, 14, and 16 on P20 are connected to ground and +5 V on the prescalers.

• *Reset Circuit*

A special reset circuit is included in the design. U8 is a special supply supervisor. If the +5 V becomes lower than 4.5 V, the reset output pin 4 goes low. This gives a micro controller reset. For test purposes the micro controller can be forced to reset by short circuiting the pads J10. The length of the reset pulse is set by C310; 2.2 µF gives a pulse of approximately 40 ms. The supervisor circuit also controls the reset pulse during the power-on, so the micro controller starts in a controlled manner.

• *Keyboard Scanning*

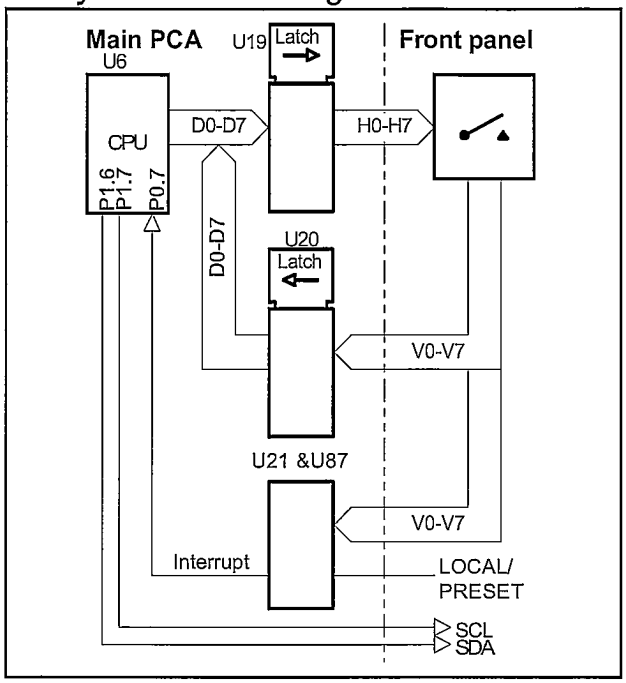

Figure 4-22 *Keyboard scanning.*

All outputs of U19 are set low one after the other. If no button is pressed, all outputs to the latch U20 are high and so are the inputs to the AND gates U21 and U87, (see Figure 4-22).

When a button is pressed, one input on the AND gates will go low. An interrupt is generated to the µ-controller U6 pin P0.7. The µ-controller reads the latch U20, and the program jumps to a special handler in the SW.

The ON button are connected to the ON/STANDBY logic in the power supply. When the counter is in STAND-BY the RESET input (pin 10) of U76 is kept high and so are the outputs of U76. A press on the ON key will discharge the capacitor C180 via the diode D24, the ON switch and the resistor R337 to ground. Pin 5 on U76 will go high making the transistor V52 active and the relay K1 will draw. Further more a short pulse is generated at V7 telling the µ-controller that the ON button have been pressed. This makes it possible to sense the difference between plugging in the line power cable or pressing the ON button.

When STAND-BY is pressed the µ-controller sets the flip-flop U76 by the signal SET-STAND-BY and the relay K1 will fall.

The LOCAL/PRESET button are connected directly to the AND gates U21 and U87.

The STAND-BY indicator on the front panel is controlled by the +5 V, via V51. +5 V off lights the STAND-BY LED.

GPIB Interface

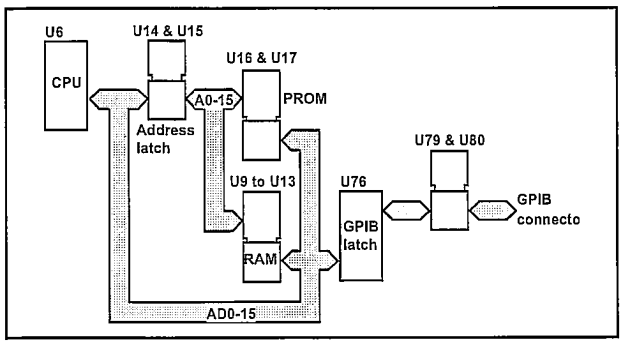

Figure 4-23 *GPIB interface.*

The GPIB interface controls the communication between the internal microprocessor and the external GPIB bus, (see Figure 4-23).

Communication between the GPIB control circuit, U78, and the external GPIB bus is done via the bi-directional bus drivers U79 and U80. U78 is controlled from the microprocessor by writing and reading in the internal control registers. If U78 has a message for the microprocessor, it uses the GPIB interrupt signal. The address of the GPIB bus is software controlled.

U9 to U13 are the RAM used to execute the program. U14 and U15 are address latches.

Analog Output

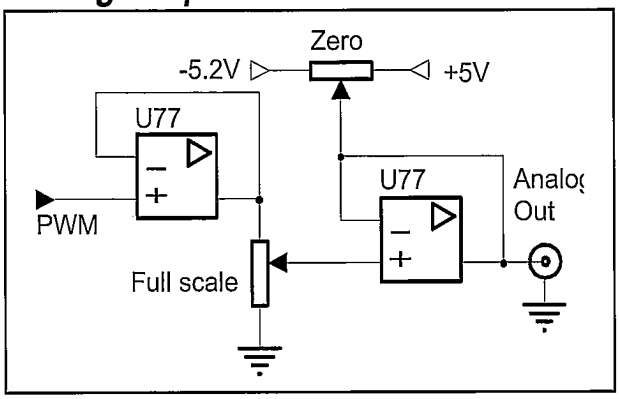

Figure 4-24 *Analog output.*

T

he result on the display can be converted to an analog signal. A digital pulse width modulated signal, PWM, from the microprocessor is filtered and integrated (U77) to give an analog DC level between 0 and 4.98 V with a resolution of 20 mV, (see Figure 4-24).

Rear Panel Unit

The rear panel consists of an aluminum panel with some mounted connectors, (see Figure 4-25). The following connectors are mounted on the rear panel:

INPUTS:

- External reference input - BNC (D)
- External arming input - BNC (E)
- Rear panel inputs (factory-mounted option)
- Power supply inlet including EMI filter

OUTPUTS:

- Internal reference output - BNC (G)
- Gate open output - BNC (H)
- Analog output (X).
- Probe compensation output.
- Trigger level output.

- A GPIB communication connector.

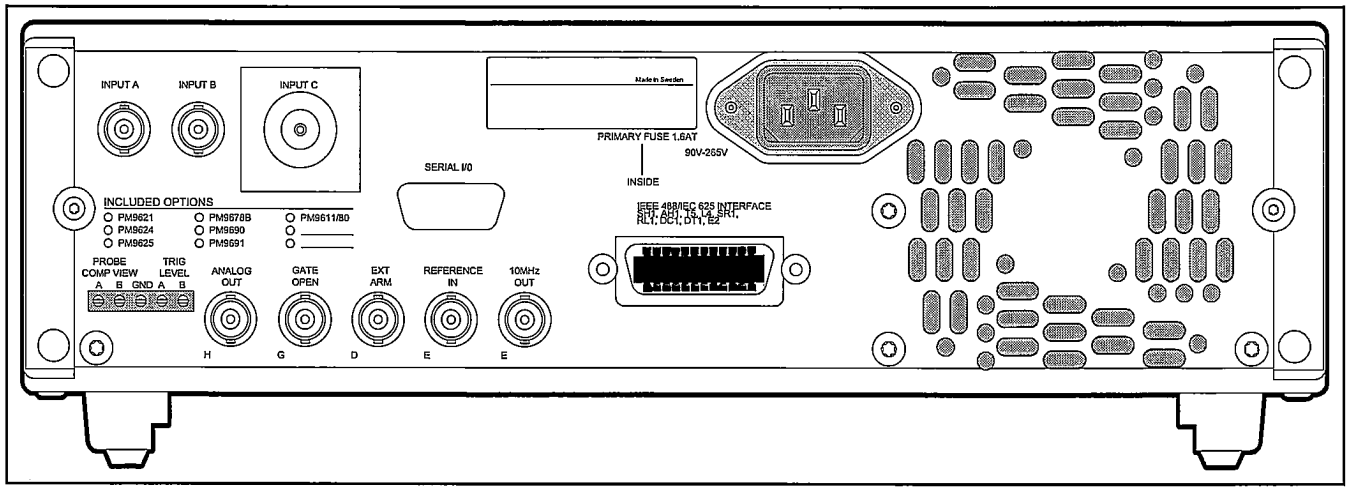

Figure 4-25 *Rear panel.*

Optional Units

HF Inputs

There is a choice of three different optional HF inputs; PM 9621, PM 9624, and PM 9625. The inputs are all mounted on the same place on the main board, to the right of the input amplifier. They are connected to P107, and only one prescaler at a time can be mounted. In BU7 there are 3 ID pins. Different prescalers have different coding of these pins. PM 9624 and PM 9625 are factory repair only, due to the need of instrumentation for high frequencies.

• *Prescaler 1.3 GHz, PM 9621*

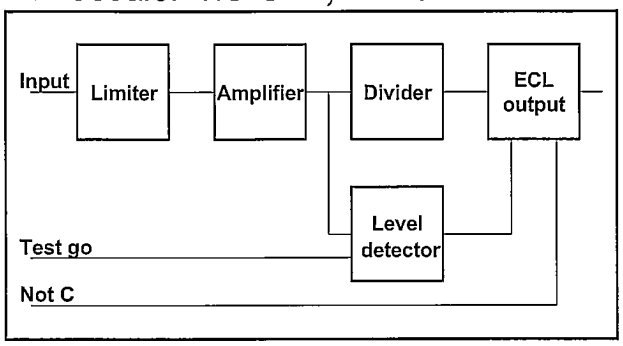

Figure 4-26 *PM 9621 Block diagram.*

The frequency range for the prescaler is 70 MHz to 1.3 GHz. To be able to be handled by the measuring logic in the counter the frequency is divided by 256. The input is AC-coupled and the input impedance is 50Ω nominal. Five main blocks makes the prescaler: Limiter, amplifier, divider, ECL output, and level detector, (see Figure 4-26).

Limiter

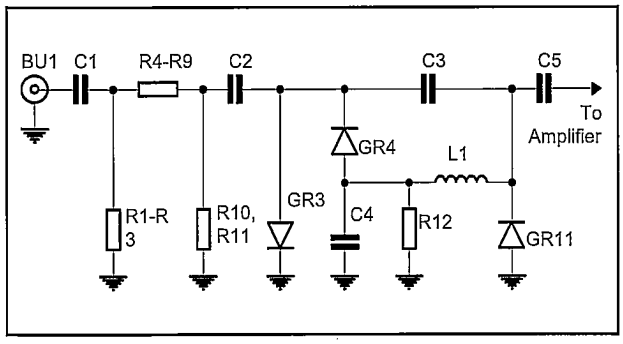

Figure 4-27 *Limiter circuits.*

The 6 dB attenuator (R1 to R11) keeps the VSWR low for all input levels, even the PIN diodes have low impedance, (see Figure 4-27). When the peak-to-peak level of the input signal is greater than the sum of the voltage drops of the Schottky diodes GR3 and GR4, the charging of capacitor C4 starts. Capacitor C4 filters the voltage after the Schottky diodes. The PIN diodes GR11 start to conduct when the voltage is lower than approximately –0.65 V.

More current through the diodes means lower impedance. This means that the HF voltage over GR11 is constant. R12 discharges C4 then the input level decreases. L1 prevents capacitor C4 from short-circuiting the HF signal.

Amplifier

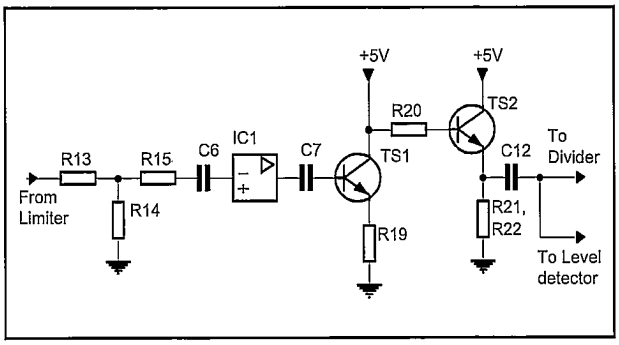

Figure 4-28 *Amplifier circuits.*

R13, R14, and R15 attenuate the HF signal 3 dB, to prevent overloading of the amplifier circuit IC1. IC1 amplifies the HF signal approximately 15 dB. TS1 amplifies the frequency range 0.9 to 1.4 GHz by 8 dB, to increase the level for these frequencies due to the falling frequency response of IC2. TS2 is an impedance converter, (see Figure 4-28).

Divider

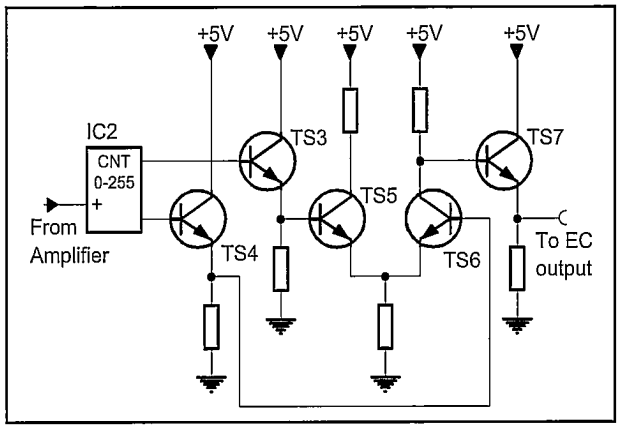

Figure 4-29 *Divider and ECL-converter circuits.*

The divider IC, IC2, divides the input frequency by 256. The output frequency is max. 5.5 MHz, (see Figure 4-29).

ECL output

TS3 and TS4 convert the output signal from IC2 to ECL levels. The rise and fall time of the output signal must be shortened. This is done in the differential amplifier TS5 and TS6. TS7 restores the ECL levels and buffers the single ended output signal, (see Figure 4-29).

Level detector

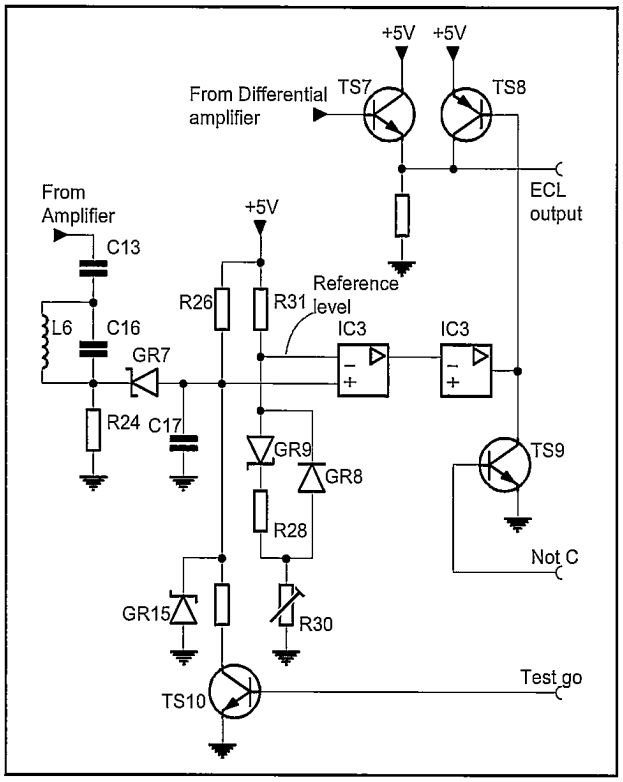

Figure 4-30 *Level detector.*

C13, C16, and L6 form a filter making the frequency response of the signal to the level detector diode GR7, the same as the signal to IC2, (see Figure 4-30).

The detector voltage is filtered and fed to IC3. Diode GR15 prevents the level from being too negative (IC3 is then lokked). The first stage in IC3 amplifies the level approximately 15 times and the second stage is a Schmitt trigger. The output from the Schmitt trigger can block, via TS8, the ECL output signal. A low output signal from IC3 pin 7 makes TS8 conduct. The ECL output signal will be 4.5 V. If IC3 pin 7 is high, TS8 is not conducting, and the output signal from TS7 is not blocked. The Schmitt trigger is controlled from the first amplifier in IC3. If the level on IC3 pin 3 (detected level) is lower than the reference level on IC3 pin 2 (an HF signal with sufficient level present), IC3 pin 1 is low and the Schmitt trigger output is high, thus not blocking the ECL output signal. The reference level on IC3 pin 2 is set by trim-potentiometer R30. GR8, GR9, and R28 form a temperature compensation circuit, to compensate for the temperature behavior of the detector diode GR7. For testing purposes, the level detection can be overruled by the signal TEST GO. A high level makes TS10 conduct, and that enables the ECL output signal, despite the HF input signal amplitude. The ECL output signal can also be switched off, despite the level detection. A high level on signal NOT C makes TS9 conduct and thus makes the level to TS8 low. TS8 makes the ECL output signal +4.5 V.

• *Prescaler 2.7 GHz, PM 9624*

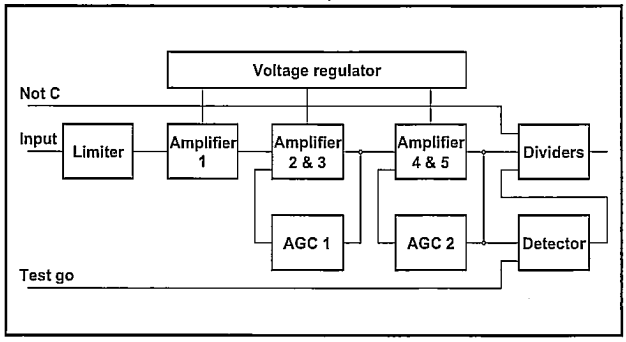

Figure 4-31 *PM 9624 Block diagram.*

The PM 9624 prescaler cannot be repaired at a local workshop. It must be sent to the factory for repair.

The prescaler consists of the following parts, (see Figure 4-31):

Limiter

– The limiter consists of a 6 dB attenuator and a PIN diode attenuator, to achieve constant input amplitude to the amplifiers.

Amplifier

– Five amplifier stages are divided into three blocks. One block consists of one amplifier. Two blocks consists of two amplifiers each and an AGC control.

Automatic Gain Control (AGC)

– Helps the amplifiers to retain a constant output amplitude.

Dividers

– Two dividers divide the input signal frequency by 16.

Detector

– Detects whether the level of the input signal is high enough to ensure correct measurement and, if not, blocks the output signal from the prescaler.

Positive Voltage Regulator

– Positive voltage supply for the amplifiers.

• *Prescaler 4.5 GHz, PM 9625*

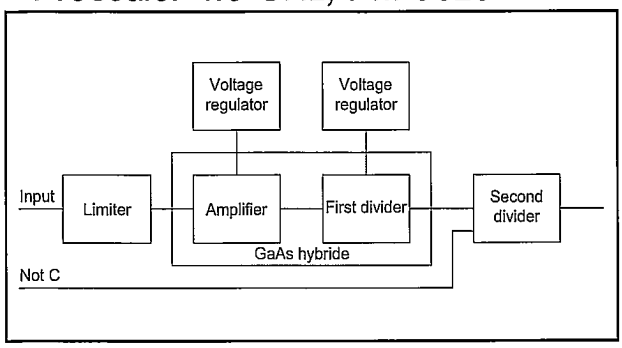

Figure 4-32 *PM 9625 Block diagram.*

The PM 9625 prescaler cannot be repaired at a local workshop. It must be sent to the factory for repair.

The prescaler consists of the following parts, (see Figure 4-32):

Limiter

– The limiter consists of a 6 dB attenuator and a PIN diode attenuator, to achieve constant input amplitude to the amplifiers.

Amplifier

– The amplifier consists of 4 cascade coupled integrated GaAs amplifiers; each amplifies approximately 8 dB.

First divider

– The GaAs divider chip consists of an input buffer, 3 divider stages, and 2 output buffer stages. The circuit divides by 8.

Second divider

– This divider divides the signal from the first divider by 4. In total the frequency is divided by 32, and the output frequency from the prescaler is 155 MHz at maximum.

Voltage regulators

– Two positive voltage regulators are used for the GaAs amplifier and the first divider.

Test Routines

Test Routines via AUX MENU Key

The test routines are the routines accessible via the aux menu key.

Refer to the PM 6681 Operators Manual.

Power-On Tests

At power on, some tests are automatically performed. Simultaneously a message is sent to the serial port of the µ-computer. The message can be read by a PC connected to the serial port. To do this perform as follows:

- Connect testpoints P5=OUT and P16=GND to a COM port on the PC.
- Run a terminal emulator program as KERMIT or Windows TERMINAL EMULATOR.

Switch on the counter.

Every time the counter is switched on the following message will be displayed on the screen:

Code start OK
Ram regs OK
Timer1 OK
Prom bank3 OK
Prom bank2 OK
Prom bank1 OK
Prom bank0 OK
Disp. Driver 1 OK
Disp. Driver 0 OK
Disp. Driver fill
Ram bank2, 2080h xor OK, 4000h fill OK
Ram bank1, 2080h xor OK, 2080h fill OK, 4000h fill OK
Ram bank0, 2080h xor OK, 2080h fill OK, 4000h fill OK
Ram bank2, 4000h zero OK, C000h zero OK
Ram bank1, 2080h zero OK, 4000h zero OK
Ram bank0, 2080h zero OK, 4000h zero OK
Asics, 0291h, 02A5h OK
PHILIPS, PM6681, 0, MAIN X1.02 Mar 24 1994 10:30:26 / GPIB X1.13 Mar 01 1994 123

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Chapter 5

Repair

Preventive Maintenance

Calibration

To maintain performance of PM 6681 we recommend that you calibrate your instrument every year, or more often, if greater time base accuracy is required. Calibration should be performed with traceable references and instruments at a certified calibration laboratory. Contact your local Fluke service center for calibration.

To know the present status of your instrument, test your timer/counter from time to time. The test can be made according to the information in Chapter 2, Performance Check.

Oscillators

The frequency of the reference crystal oscillator is the main parameter affecting accuracy in a counter. The frequency is affected by external conditions like the ambient temperature and supply voltage, but also by aging. When recalibrating, the reference crystal oscillator is compensated only for deviation in frequency due to aging.

• *Some important points:*

- The high stability oscillators have been built into an oven in order to keep the oscillator temperature as stable as possible. Continuous operation is also important for stability. After a power interruption, the oscillator restarts at a slightly different frequency. It will then, as time goes on, age at an equal rate.
- The stability indicated for the oscillators is valid within a temperature range of 0 to 50°C, with a reference temperature of 23°C. If the timer/counter is used in a room temperature of 20 to 30°C, the temperature stability of a TCXO or OCXO will be increased by a factor of 3.
- The temperature stability indicated for TCXO and standard oscillators are mainly dependent on the ambient temperature. When operating there is always a temperature increase inside the counter which will influence the oscillator.

• *Recalibration intervals*

The Mean Time Between ReCalibration, MTBRC, is defined as:

$$MTBRC = \frac{(Acceptable\ error) - (Temperature\ stability)}{(Aging)}$$

MTBRC can be calculated when the total acceptable error and the oscillator specifications are known.

The total acceptable error is defined as:

$$(Acceptable error) = \frac{(Deviation of reference\ frequency)}{(Nominal\ frequency reference)}$$

Example:

- A user can accept a maximum of 3 Hz deviation on the 10 MHz frequency of the oscillator. This results in:

$$(Acceptable error) = \frac{3}{10*10^6} = 3*10^{-7}$$

The aging and temperature factors can be selected from the table on page 5-3.

The value of the aging factor is correctly selected from the table when the calculation of MTBRC results in 1 to 30 days (use */24h*), 1 to 12 months (use */month*) or over 1 year (use */year*) (not, e.g., 43 days or 17 months or 0.8 years).

Example:

- The user has the same requirements as in the example above. The counter has a PM 9690 oscillator.
- Look up information about PM 9690 in the table on page 5-3. The results will be the following:

Relative Frequency deviation caused by:

- Ambient temperature deviation (within 0 to 50°C; reference point at 23°C): Less than $1.5 * 10^{-8}$
- Aging/year: Less than $1 * 10^{-7}$

- Use the MTBRC formula with the above values. This gives a MTBRC of maximum:

$$\frac{(3*10^{-7}) - (1.5*10^{-8})}{1*10^{-7}} = 2.9\ year$$

See also Figure 5-1, Figure 5-2, and Figure 5-3.

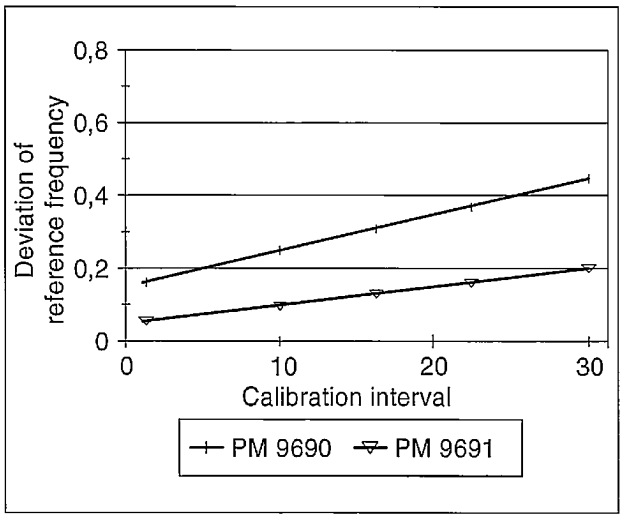


Figure 5-1 *MTBRC in days.*

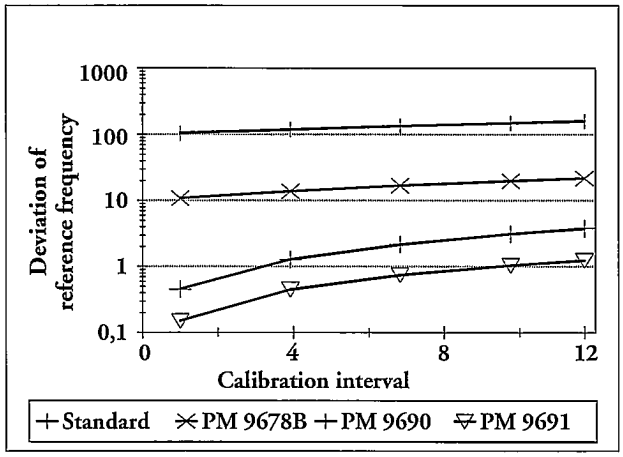


Figure 5-2 *MTBRC in months.*

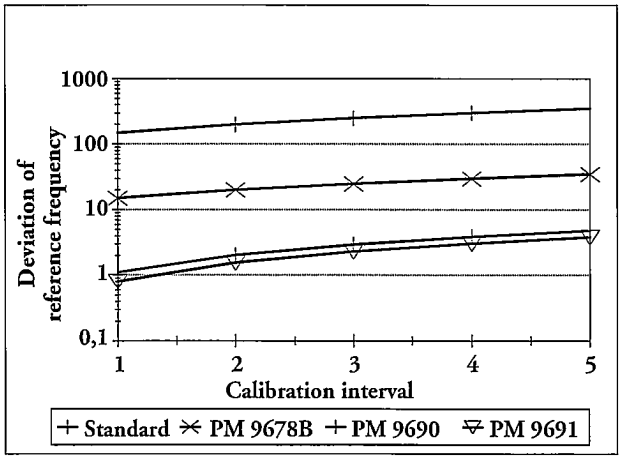


Figure 5-3 *MTBRC in years.*

NOTE: When recalibrating, the reference crystal oscillator will be compensated only for frequency deviation caused by aging.

	Model Options			
Stability against	/.1.	/.2.	/.4.	/.5.
		PM 9678B	PM 9690	PM 9691
	Standard	TCXO	Oven	Oven
Aging: /24h	n.a.	n.a.	$<1 * 10^{-9}$*	$<5 * 10^{-10}$*
Aging: /month	$<5 * 10^{-7}$	$<1 * 10^{-7}$	$<2 * 10^{-8}$	$<1 * 10^{-8}$
Aging: /year	$<5 * 10^{-6}$	$<5 * 10^{-7}$	$<1 * 10^{-7}$	$<7.5 * 10^{-8}$
Temperature: 0 to 50°C ref. to + 23°C	$<1 * 10^{-5}$	$<1 * 10^{-6}$	$<1.5 * 10^{-8}$	$<5 * 10^{-9}$
Line Voltage ± 10%	$<1 * 10^{-8}$	$<1 * 10^{-9}$	$<5 * 10^{-10}$	$<5 * 10^{-10}$
Warm-up Time to Reach 10^{-7} of Final Value	n.a.	n.a.	< 15 min	< 15 min

Table 5-1

* after 48 hours of continuous operation

Battery Replacement

To preserve data and variables needed for the use of PM 6681 a lithium battery is included. The lithium battery has an estimated lifetime of five to ten years. We recommend an replaceing the battery every five years to avoid loss of data in operation.

When battery is empty, the timer/counter will lose all settings, and any data in memory, if disconnected from line power.

See "Reinstalling the Battery" on page 3-4.

Troubleshooting

General

Quick Troubleshooting

The PM 6681 is a highly integrated Timer/Counter with dedicated LSI counter circuits and microcontrollers that control the complete units. The microcontroller can help you to locate faulty parts by running test programs and generating stable signal patterns on the bus. If the microcontroller does not work or the fault is in a part of the counter that cannot be accessed by the microcontroller, traditional fault-finding must be performed.

Where to Start

After reading the safety instructions, continue with this Chapter for faultfinding and repair instructions. When you have fixed the instrument, always do the Safety Inspection and Test after Repair, as described later in this Chapter. Then do the checks in Chapter 2, Performance Check. Recalibrate if required by following the adjustment instructions in Chapter 6, Calibration Adjustments.

Logical Levels

The PM 6681 contains logic of four families. The levels for these families are listed in Table 5-2.

	Positive ECL	Negative ECL	CMOS	TTL
Supply voltage	+5 V	-5 V	+5 V	+5 V
Signal ground	0 V	0 V	0 V	0 V
Input voltage				
High, V_{IH}	>+3.9 V	>-1.1 V	>+4 V	>+2 V
Low, V_{IL}	<+3.5 V	<-1.5 V	<+1 V	<+0.8 V
Output voltage				
High, V_{OH}	>+4 V	>-1 V	>+4.9 V	>+2.7 V
Low, V_{OL}	<+3.3 V	<-1.7 V	<+0.05 V	<+0.4 V
Bias ref. voltage, V_{BB}	+3.7 V	-1.3 V	-	-

Table 5-2 *Logical levels.*

Required Test Equipment

To be able to test the instrument properly using this manual you will need the equipment listed in Table 5-3. The list contains not only suggested Fluke test equipment, but also the critical parameter specifications required if you have instruments from other manufacturers.

Type	Performance	Model No
DMM	-	PM 2518 or 77
Oscilloscope	50 Mhz 2-channel	PM 3050
Signal generator	1300 MHz	6062A
BNC-BNC cables	-	-

Table 5-3 *Required test equipment.*

Operating Conditions

Power voltage must be in the range of 90 to 260 VAC.

Introduction

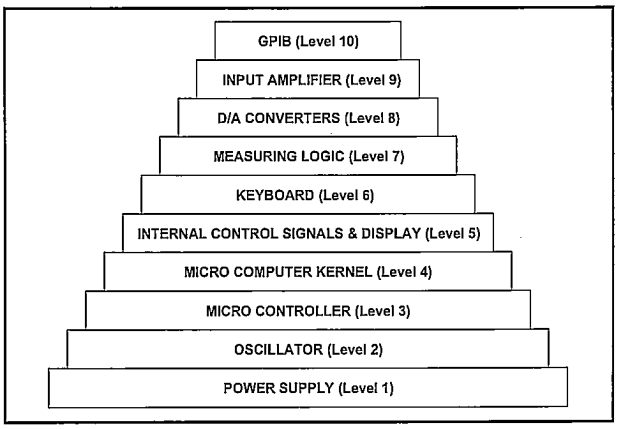


Figure 5-4 *Functional levels.*

The troubleshooting strategy in PM 6681, is an integrated part of the overall service strategy for the instrument. This instrument is hierarchically designed in different levels, see Figure 5-4, and troubleshooting can be performed in any design level if the lower levels are OK. It is therefore important to disconnect all options in the beginning of the troubleshooting procedure.

Running Test Programs

The service functions are activated by connecting the two solder points, labeled TEST, J11 during startup, see Figure 5-6.

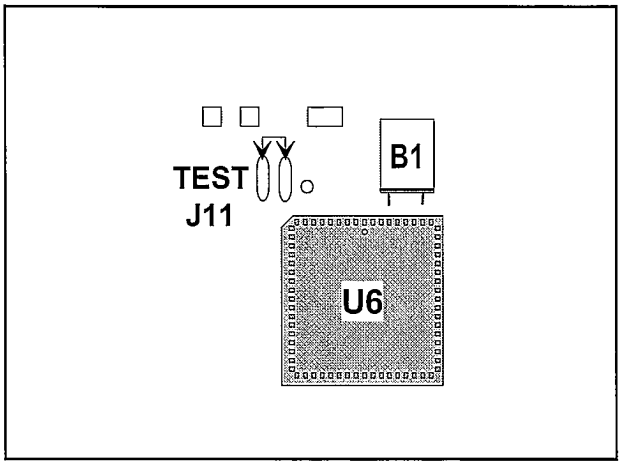


Figure 5-6 *The service functions are activated by connecting the two solder points, labeled TEST, J11 during startup.*

– Switch on the counter.

The ROM test, RAM test, and µC Kernel test runs automatically. After the display test the test-program starts from the beginning again. Use LOCAL/PRESET to step through the different tests.

NOTE: The address test and display test are described under Level 4 and Level 5 respectively, but they cannot be run before you have checked Level 6.

Text	Function	Level	Exit
test rO	ROM test	3	Automatically
test rA	RAM test	3	Automatically
test Core	µC Kernel test	3+4	LOCAL/PRESET
test relay	Control signal test	5	LOCAL/PRESET
test buttn	Keyboard test	6	LOCAL/PRESET
test Addr.	Address test	4	LOCAL/PRESET
test ASIC	ASIC's test 1	7	Automatically
test ASIC	ASIC's test 2	7	LOCAL/PRESET
test dAC	DAC test	8	LOCAL/PRESET
test ANALO	Analog out test 1	10	LOCAL/PRESET
85	Analog out test 2	10	LOCAL/PRESET
8888888888	Display test	5	LOCAL/PRESET

Table 5-4 *Test programs.*

Troubleshooting Tree

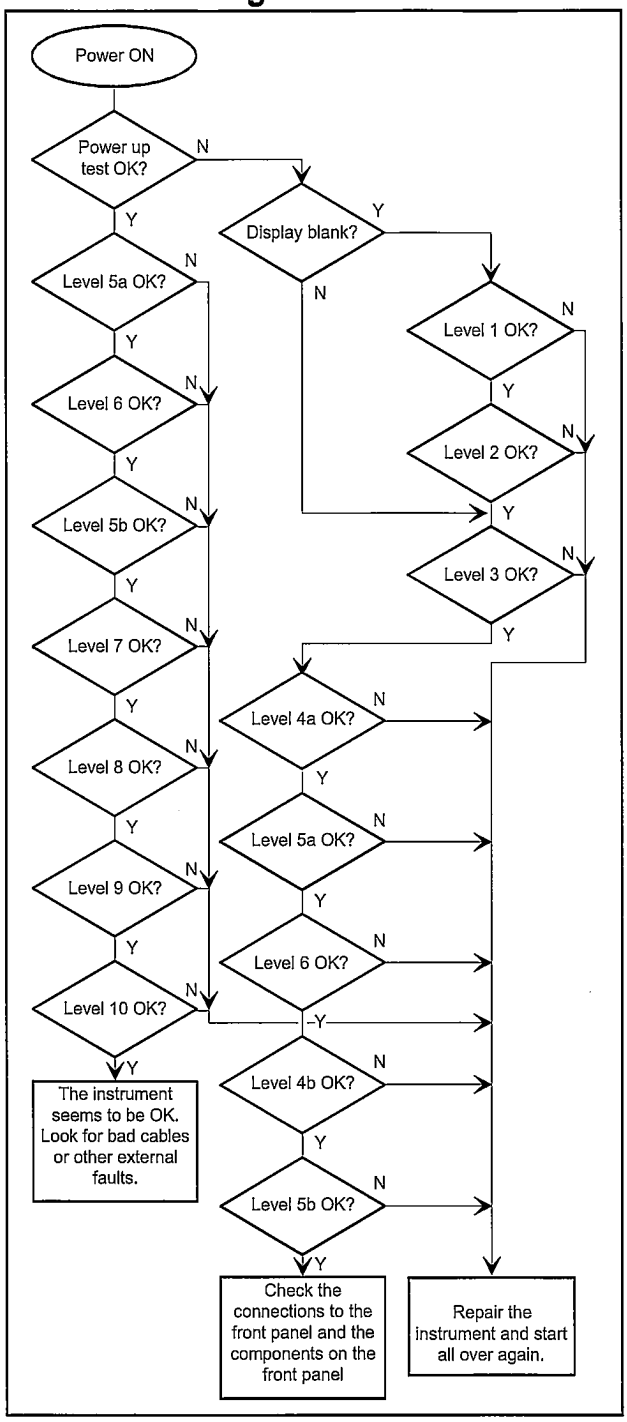


Figure 5-5 *Troubleshooting tree.*

The levels mentioned in the troubleshooting tree refer to the functional levels in Figure 5-4. For example Level 3 are equal to Microcontroller (3). (Do the microcontroller check later in this Chapter.)

Power Supply (Functional Level 1)

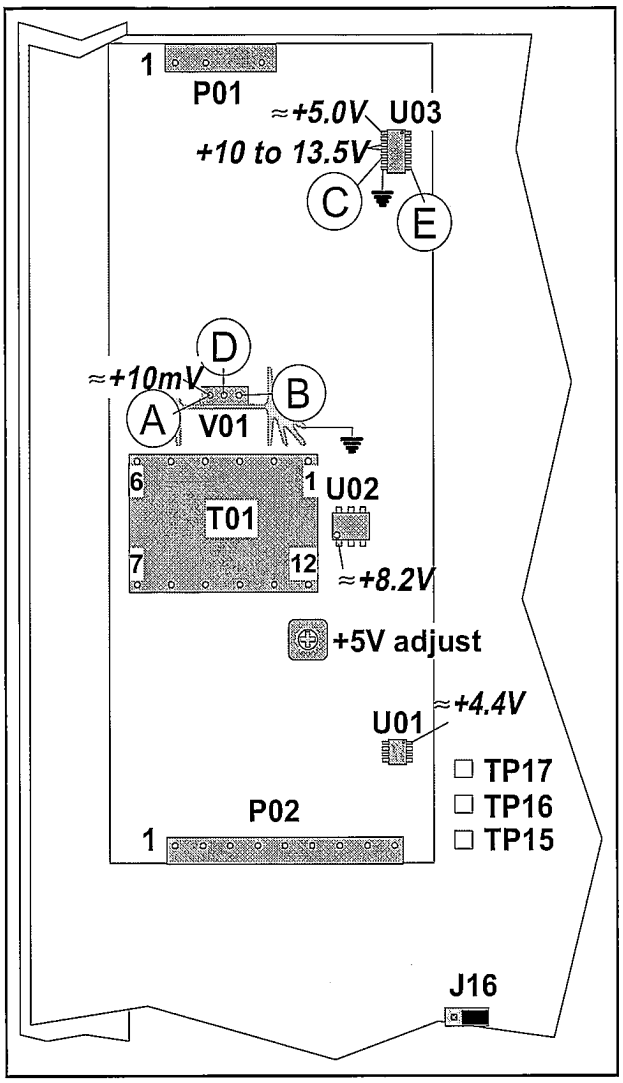


Figure 5-7 *Test points and voltages for the power supply.*

WARNING: Live parts and accessible terminals which can be dangerous to life are always exposed inside the unit when it is connected to the line power. Use extreme caution when handling, testing or adjusting the counter.

Primary circuits

To verify the Power supply proceed as follows:

- If the primary fuse is broken, there is a short circuit in the primary circuits. Use a DMM and try to locate the fault by resistance measuring.
- Remove the cover from the Power Supply.

WARNING: The heat sink inside the power supply is connected to the line power.

- Disconnect L39 and L40 and check the resistance between pin 1 and 4 on the transformer T1, see Figure 5-7. If the DMM show a short circuit the fault is proabably a broken transistor V55. Put L39 and L40 back in position.
- Connect the counter to the line power via an insulating transformer with separate windings.
- Set the counter to STAND-BY mode.
- Check that the voltage between P19 and P23 is in the range of 90 to 260 VAC.
- Check that the DC voltage between pin 1 and 4 on T1 is about $\sqrt{2}$ times the input AC-voltage. If not, use traditional faultfinding techniques to locate the fault.
- Remove the jumper J15.
- Check the "STAND BY" voltages according to Table 5-5.

Test points	Ground	Voltage
U91 pin 11 & 12	U91 pin 8	+10 to +13.5 V
U91 pin 14	U91 pin 8	≈+5.0 V
V55 source	U91 pin 8	≈+10 mV
U90 pin 1	L41	≈+8.2 V
U92 pin 1	L41	≈+4.4 V
X10	L41	≈+5.1 V
X11	L41	+14.8 V to +21 V
X12	L41	–12.5 V to –7.5 V
X13	L41	+12 V ±0.5 V

Table 5-5 *Stand-by voltages.*

- Reinstall the jumper J15.
- Check the curveforms according to Figure 5-8 and Figure 5-7 to verify the primary circuits. Use the heatsink of V55 as ground.

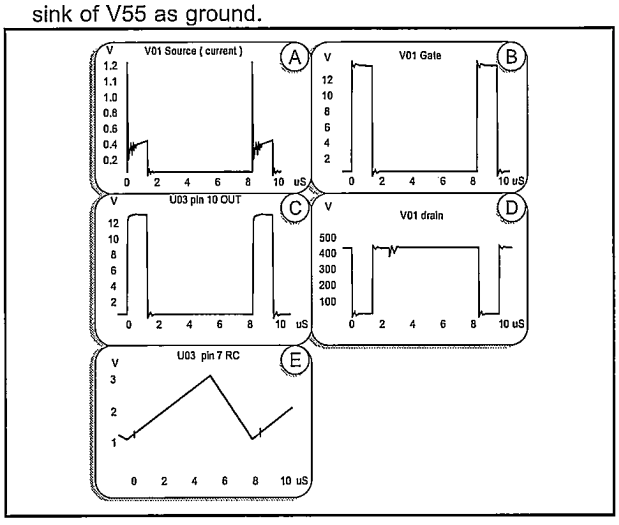


Figure 5-8 *Typical curves of the power supply.*

NOTE: U91 and U92 are located at the bottom side of the PCA.

Secondary circuits

- Connect the power cable to the counter.
- Switch ON the counter.

CAUTION: If you adjust the +5 V trimmer you have to adjust the complete instrument.

– Check the "POWER ON" voltages according to Table 5-6. Use L41 as ground.

Test points	Voltage
X15	+5.01 V ±30 mV*
X16	–5.1 V ±50 mV
X14	+7 V ±100 mV
X17	+12 V ±100 mV

Table 5-6 *Power-on voltages.*

**NOTE: If the +5 V voltage is outside the specification, all other levels will be wrong, since they are based on the +5 V level.*

If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. See also Chapter 4, Circuit Descriptions, Power Supply.

Oscillator (Functional Level 2)

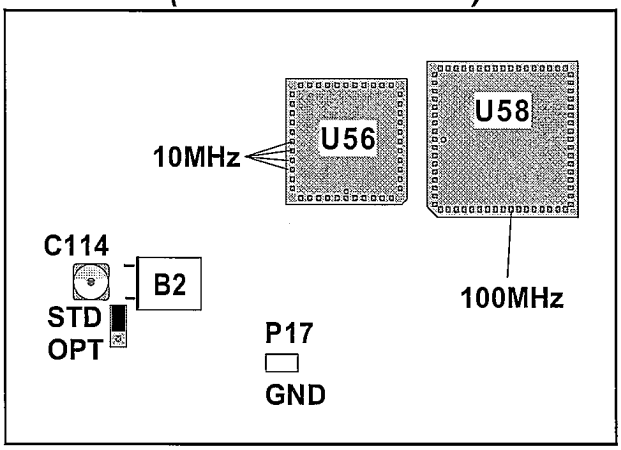


Figure 5-9 *Test points and jumper for testing the oscillators.*

• Standard Oscillator

– Be sure that jumper J12 are in the STD position, see Figure 5-9.
– Check that 10 MHz is present at U56 pins 34, 35, 36 and pin 37.
– Check that 10 MHz is present at the rear panel connector 10 MHz OUT, J7.
– Check that 100 MHz is present at U58 pin 19.

If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. See also Chapter 4, Circuit Descriptions, Oscillator Circuits.

• Optional Oscillator, PM 9678B

This test can be carried out only if the counter is equipped with an optional oscillator, PM 9678B.

– Be sure that jumper J12 are in the OPT position, see Figure 5-9.
– Check that 10 MHz is present at U56 pins 34, 35, 36 and pin 37.
– Check that 10 MHz is present at the rear panel connector 10 MHz OUT, J7.
– Check that 100 MHz is present at U58 pin 19.

If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. See also Chapter 4, Circuit Descriptions, Optional Oscillator, PM 9678B.

• Optional Oscillator, PM 9690 and PM 9691

This test can be carried out only if the counter is equipped with an optional oscillator, PM 9690 or PM 9691.

– Be sure that jumper J12 are in the OPT position, see Figure 5-9.
– Check that 10 MHz is present at U56 pins 34, 35, 36 and pin 37.
– Check that 10 MHz is present at the rear panel connector 10 MHz OUT, J7.
– Check that 100 MHz is present at U58 pin 19.

These oscillators cannot be repaired in a local workshop. They must be sent to the factory for repair.

Microcontroller (Functional Level 3)

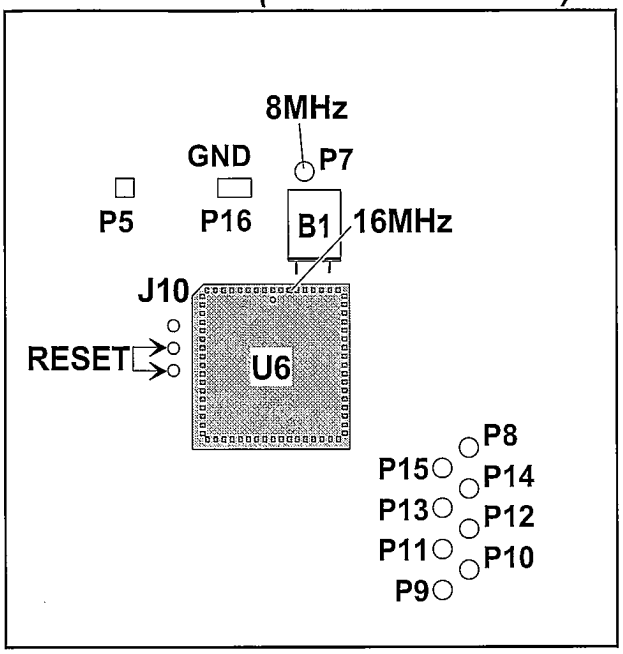


Figure 5-10 *Test points and jumpers for testing the microcontroller.*

- Check that 16 MHz is present at U6 pin 67, see Figure 5-10.
- Check that 8 MHz is present at P7.
- Check that the RESET circuitry U8 works properly by short circuiting the above shown pads.

At power on, some tests are automatically performed. Simultaneously a message is sent to the serial port of the µ-computer. The message can be read by a PC connected to the serial port. To do this perform as follows:

- Connect testpoints P5=OUT and P16=GND to a COM port on the PC.
- Run a terminal emulator program as KERMIT or Windows TERMINAL EMULATOR.
- Switch on the counter.

Every time the counter is switched on the following message will be displayed on the screen:

Code start OK
Ram regs OK
Timer1 OK
Prom bank3 OK
Prom bank2 OK
Prom bank1 OK
Prom bank0 OK
Disp. Driver 1 OK
Disp. Driver 0 OK
Disp. Driver fill
Ram bank2, 2080h xor OK, 4000h fill OK
Ram bank1, 2080h xor OK, 2080h fill OK, 4000h fill OK
Ram bank0, 2080h xor OK, 2080h fill OK, 4000h fill OK
Ram bank2, 4000h zero OK, C000h zero OK
Ram bank1, 2080h zero OK, 4000h zero OK
Ram bank0, 2080h zero OK, 4000h zero OK
Asics, 0291h, 02A5h OK
PHILIPS, PM6681, 0, MAIN X1.02 Mar 24 1994 10:30:26 / GPIB X1.13 Mar 01 1994 123

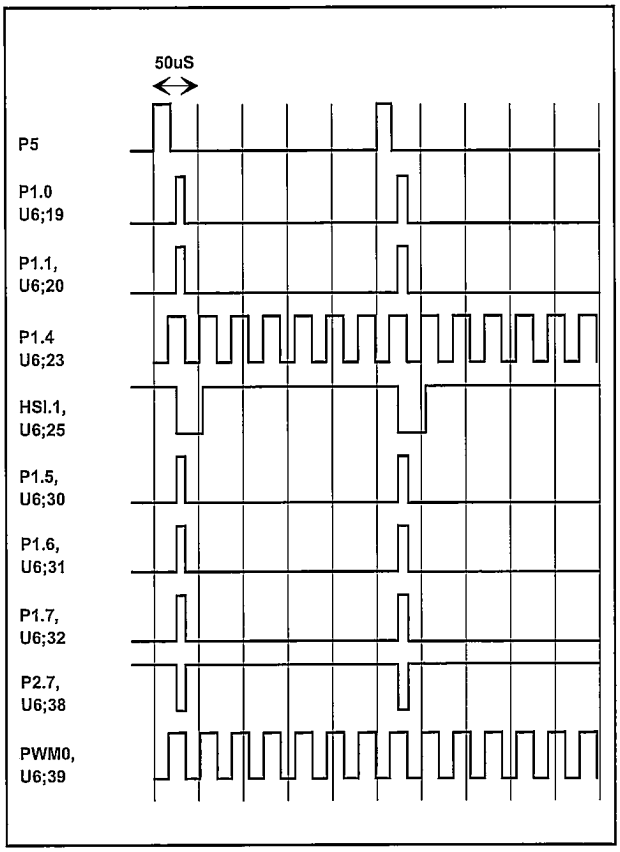


Figure 5-11 *Timing diagram for µ-controller.*

- Run µC Kernel test, Test 3.
- Set the oscilloscope to 0.2 V/div and 50 µs/div.
- Check the output signals from the µC, U6, see Figure 5-10. Use test pin P5 to trigger the oscilloscope.
- The timing diagram, Figure 5-11, shows the signals generated by the stimuli program.

If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. See also Chapter 4, Circuit Descriptions, Logical Circuits.

NOTE: Check that activity is going on at U6 pin 62 (ALE), U6 pin 61 (RD), U6 pin 63 (INST), U6 pin 40 (WR/WRL), U6 pin 41 (BME/WRH), and U6 pin 43 (READY). These pins should not be stuck to HIGH or LOW.

- If one or more bits on the AD-bus are corrupt, the µC often reads the same instructions repeatedly. When the µC discovers are invalid OP code, it will RESET itself and start from the beginning again. The µC sets the RESET input low when it resets itself. This can be discovered at the RESET input of U6, (pin 16). If +5 V to U8 is OK, this could be the case.

Microcomputer Kernel (Functional Level 4a)

Set the oscilloscope to 2 V/div and 20 µs/div.

- Run µC Kernel test, Test 3.
- Check all signals on U9 to U13, U16 and U17. The signals should not be stuck high or low. Use test pin P5 to trigger the oscilloscope, see Figure 5-12.

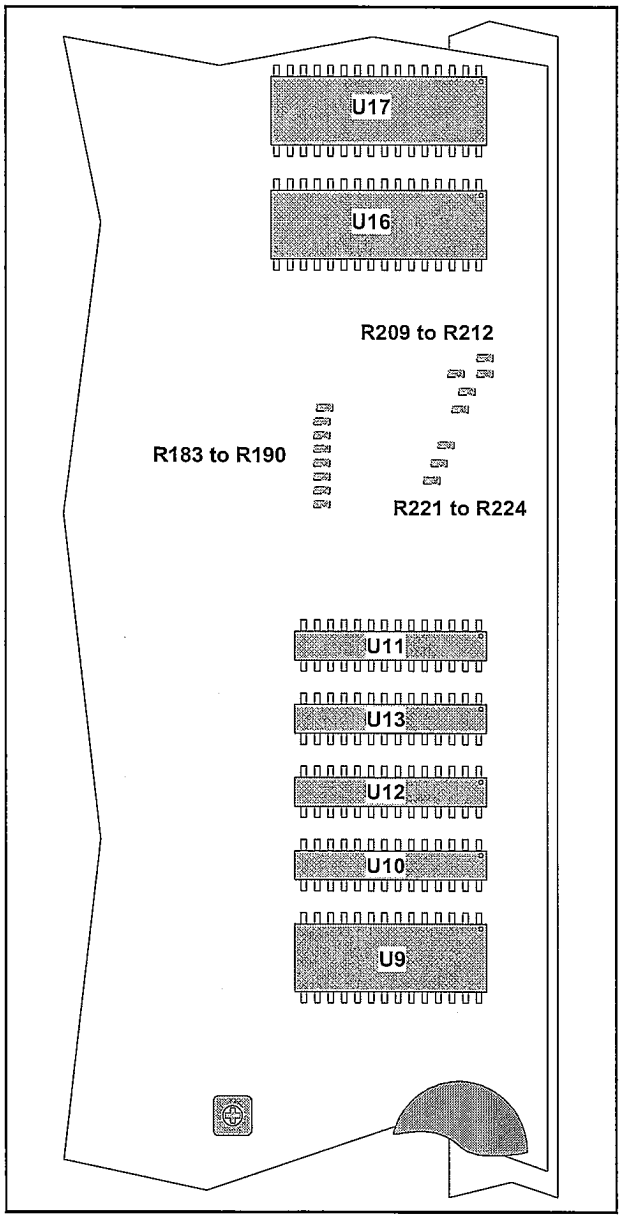


Figure 5-12 *Pinning diagram for U9 to U16.*

NOTE: By removing R183 to R190, R209 to R212, and R221 to R224 the microcomputer kernel (AD0-AD15) can be separated from the rest of the counter logic.

NOTE: These resistors are located at the bottom side of the PCA.

If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. See also Chapter 4, Circuit Descriptions, Logical Circuits.

Microcomputer Kernel (Functional Level 4b)

NOTE: It is not possible to run this test before you have run the Keyboard test, Test 5.

- Set the oscilloscope to 2 V/div. on channel A and B.
- Set the time base to 0.5 µs/div.
- Use pin 40 on U6 to trigger the oscilloscope.
- Run the Address test, Test 6.
- Enter the data code 85 (hex 55) on the DATA ENTRY keypad.
- Press ENTER.
- Enter the address code 43690 (hex AAAA) on the DATA ENTRY keypad.
- Press ENTER.
- Examine the DATA bus lines AD0-AD15 (U6 pin 45-60) with the probe connected to the A-channel, and compare the signal to with Figure 5-13.

The interesting part of the data bus signal is the grayed area on the figure.

- Press LOCAL/PRESET.
- Enter the data code 170 (hex AA) on the DATA ENTRY keypad.
- Press ENTER.
- Enter the address code 43690 (hex AAAA) on the DATA ENTRY keypad.
- Press ENTER.
- Examine the DATA bus lines.
- Press LOCAL/PRESET.
- Enter the data code 170 (hex AA) on the DATA ENTRY keypad.
- Press ENTER.
- Enter the address code 21845 (hex 5555) on the DATA ENTRY keypad.
- Press ENTER.
- Examine the DATA bus lines.
- Press LOCAL/PRESET.
- Enter the data code 85 (hex 55) on the DATA ENTRY keypad.
- Press ENTER.
- Enter the address code 21845 (hex 5555) on the DATA ENTRY keypad.
- Press ENTER.
- Examine the DATA bus lines.
- Press LOCAL/PRESET.

If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. See also Chapter 4, Circuit Descriptions, Logical Circuits.

CAUTION: Do not enter an address code between E000 and FFFF because this changes the status of the RAM, which has battery backup. This can cause irregular operation of the counter when in normal use.

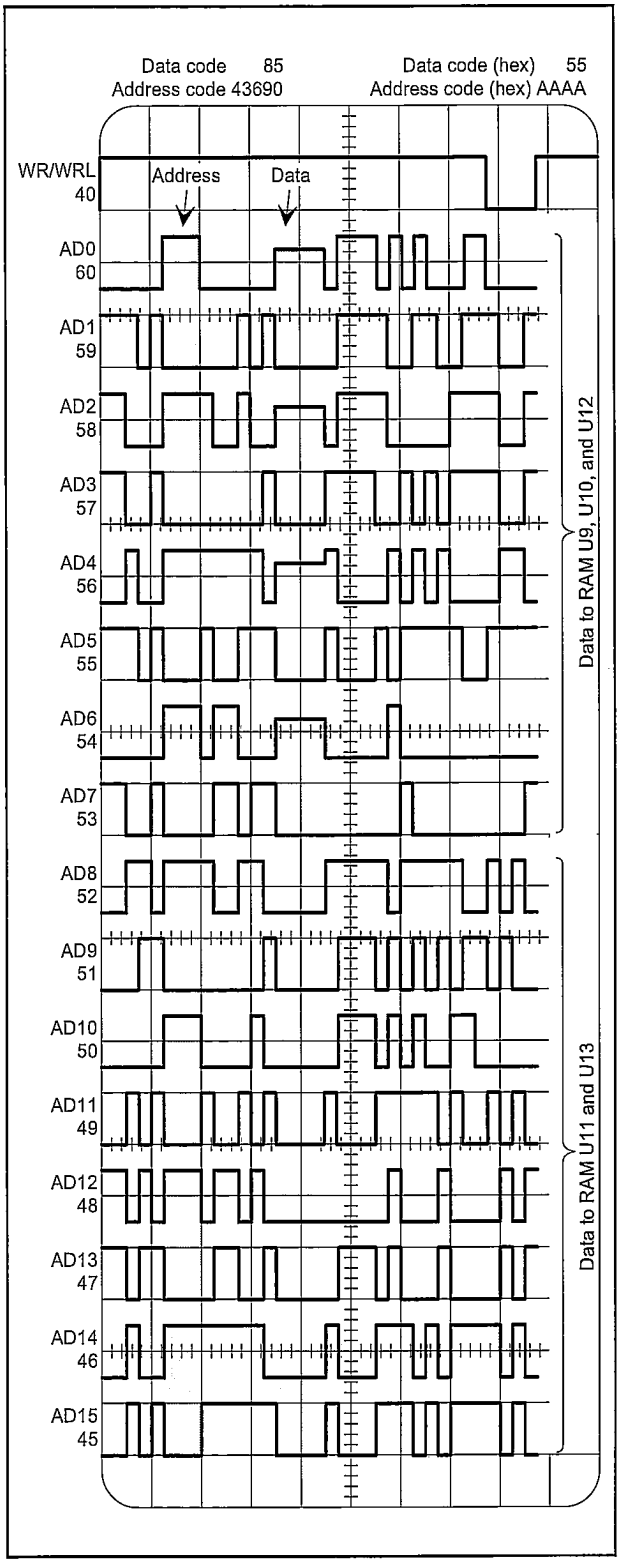


Figure 5-13 *Example of AD-bus line diagram.*

Internal Control Signals and Display (Functional Level 5a)

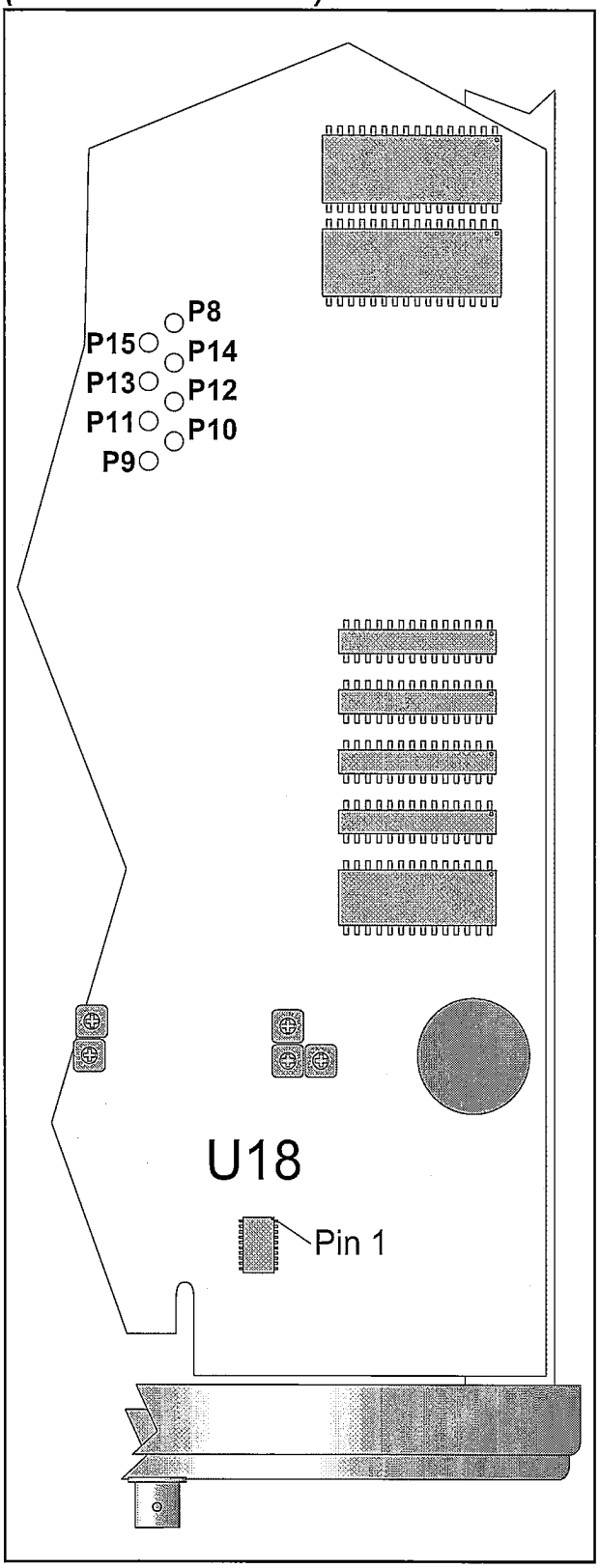


Figure 5-14 *Display driving signals and internal control signals can be measured here.*

– Run the Control signal test, Test 4.
– Set the oscilloscope to 0.2 V/div and 50 µs/div.
– Check the output signals of U18, see Figure 5-14. Use test pin P5 to trigger the oscilloscope.

NOTE: U18 is located at the bottom side of the PCA.

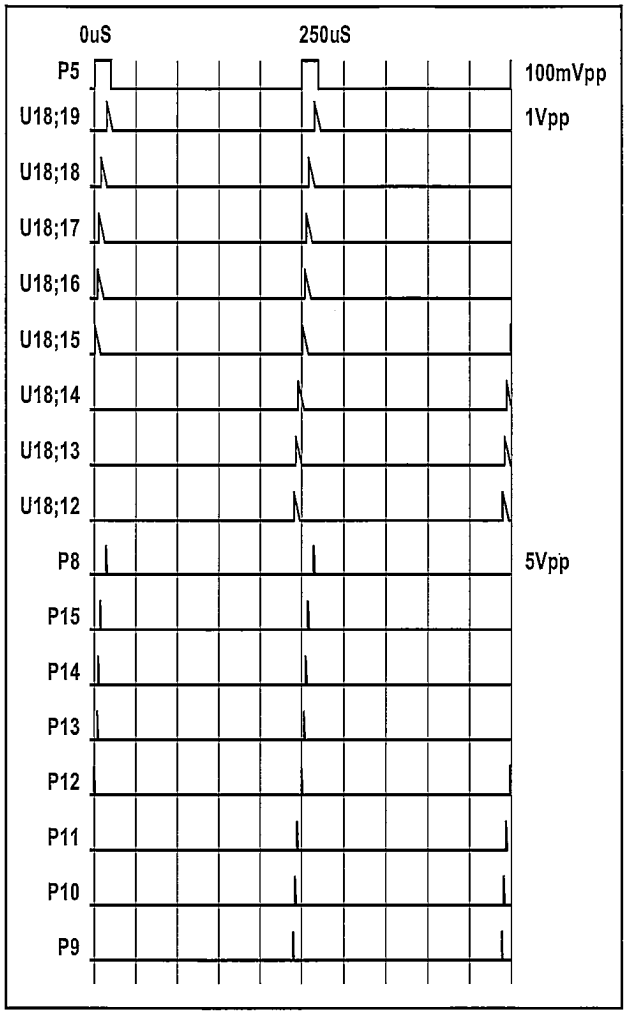


Figure 5-15 *Timing diagram for Control signals.*

– The timing diagram in Figure 5-15 shows the signals generated by the stimuli program.

If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. See also Chapter 4, Circuit Descriptions, Logical Circuits.

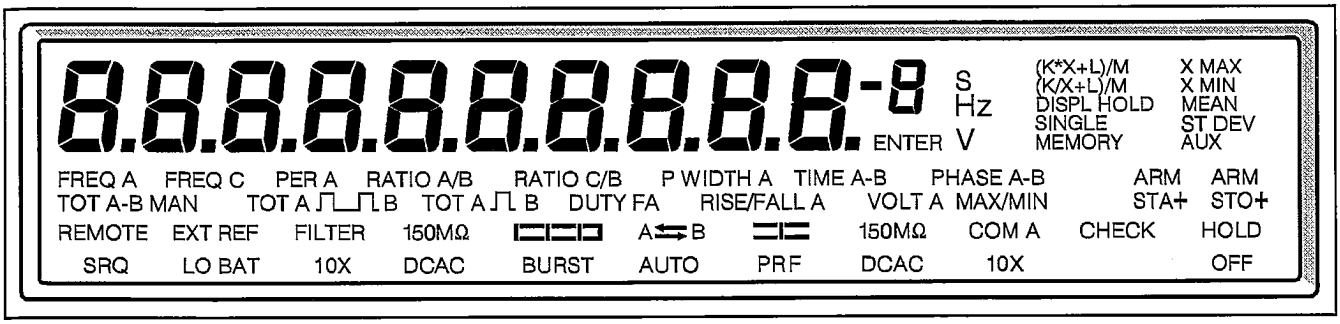


Figure 5-16 *Display readout, test 12.*

Internal Control Signals and Display (Functional Level 5b)

NOTE: It is not possible to run this test before you have run Keyboard test, Level 6.

- Run DISPLAY test, Test 12.
- Check the validity of the display readout according to Figure 5-16.

Keyboard (Functional Level 6)

- Run the Keyboard test, Test 5.
- Press a pushbutton on the front panel and check that the displayed code are as in the Figure 5-17.

NOTE: The STAND BY/ON and LOCAL/PRESET pushbuttons cannot be tested with this tool.

If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. See also Chapter 4, Circuit Descriptions, Front Unit, and Keyboard Scanning.

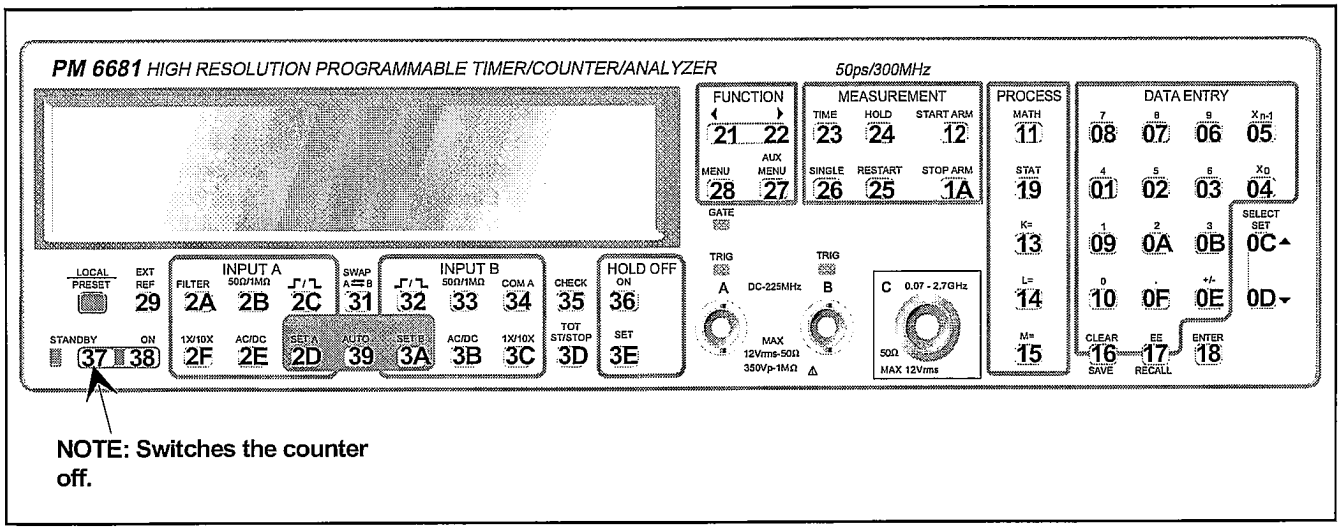


Figure 5-17 *Codes for each key, Test 5.*

Measuring Logic (Functional Level 7)

• ASIC Stimuli

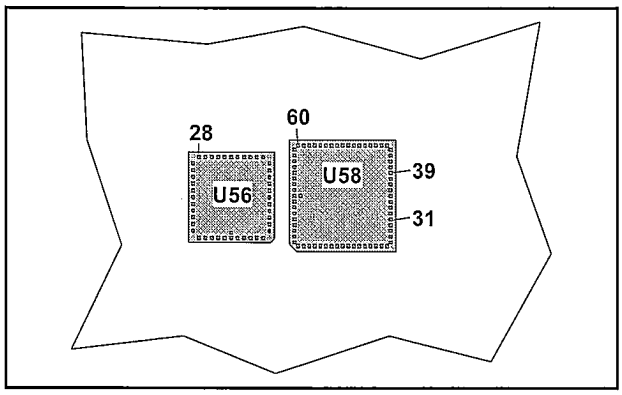


Figure 5-19 *Pinning diagram for U56 and U58.*

– Run the ASIC tests, Test 7 and 8.

NOTE: Test 6 runs automatically without stimuli signals.

– Set the oscilloscope to 2 V/div and 50 µs/div.

– Check all signals on U56 and U58. Use P5 to trigger the oscilloscope, see Figure 5-19.

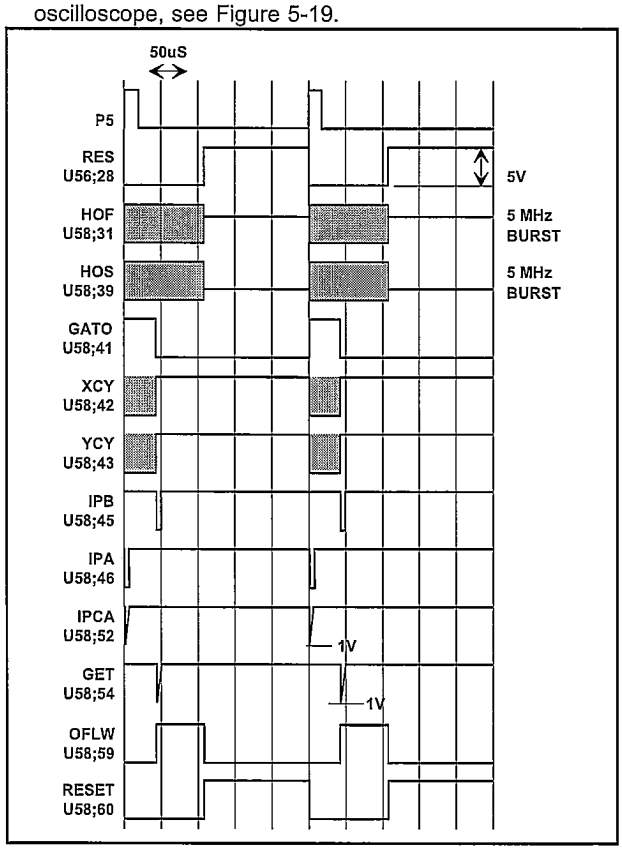


Figure 5-18 *Timing diagram for ASIC stimuli test program.*

– The timing diagram in Figure 5-18 shows the signals generated by the stimuli program.

If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. See also Chapter 4, Circuit Descriptions, Counter Circuits.

The following tests should be done with the standard PROM installed in the counter.

– Switch on the counter.
– Connect an arbitrary signal to the EXT ARM input, J5 at the rear panel.
– Trace the signal from J5 to U58 pin 27.
– Connect a 10 MHz signal to the REFERENCE IN input, J6 at the rear panel.
– Trace the signal from J6 to U56 pin 38.
– Select EXT REF.
– Trace the signal from U56 pin 35 to the 10 MHz OUT, J7 at the rear panel.
– Trace the signal from U58 pin 41 to GATE OPEN output, J4 at the rear panel.
– Trace the signal from U58 pin 37 and 38 to J17 pin 30 and 34 at the front panel and to the display and keyboard board.

If you find any fault, replace the defective circuits. See also Chapter 4, Circuit Descriptions, Counter Circuits.

Trigger Level DAC's (Functional Level 8)

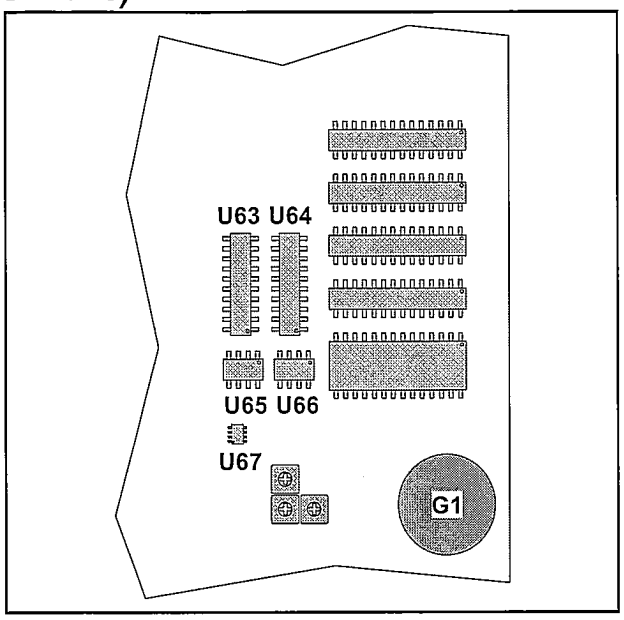


Figure 5-20 *Trigger level DACs, U63 and U64.*

– Run the DAC test, Test 9.
– Use test pin P5 to trigger the oscilloscope.

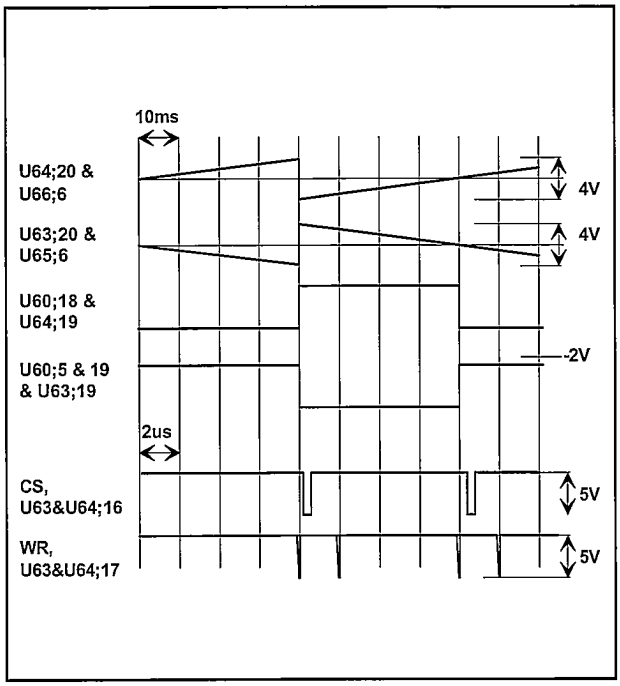


Figure 5-21 *Timing diagram for Trigger level DAC's.*

A sawtooth signal of approximately 12.5 Hz is generated on both the A and B trigger levels. The sawtooth spans over the complete trigger level range, and the B value equals the A value multiplied by -1. This means that both signals can be added by using the oscilloscopes ADD TRACE function with the result of approximately zero.

– Check all signals on U63 to U67.

NOTE: U3, and U67 are located at the bottom side of the PCA, see Figure 5-20 and Figure 5-21.

– Trace the signal from U65 and U66 pin 6, to TRIGGER LEVEL A and B OUT, P111 pin 1 and 2 at the rear panel.
– Connect TRIGGER LEVEL A and B OUT to the oscilloscope and check the result by using the ADD TRACE function.

If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. See also Chapter 4, Circuit Descriptions, Trigger Level Circuits.

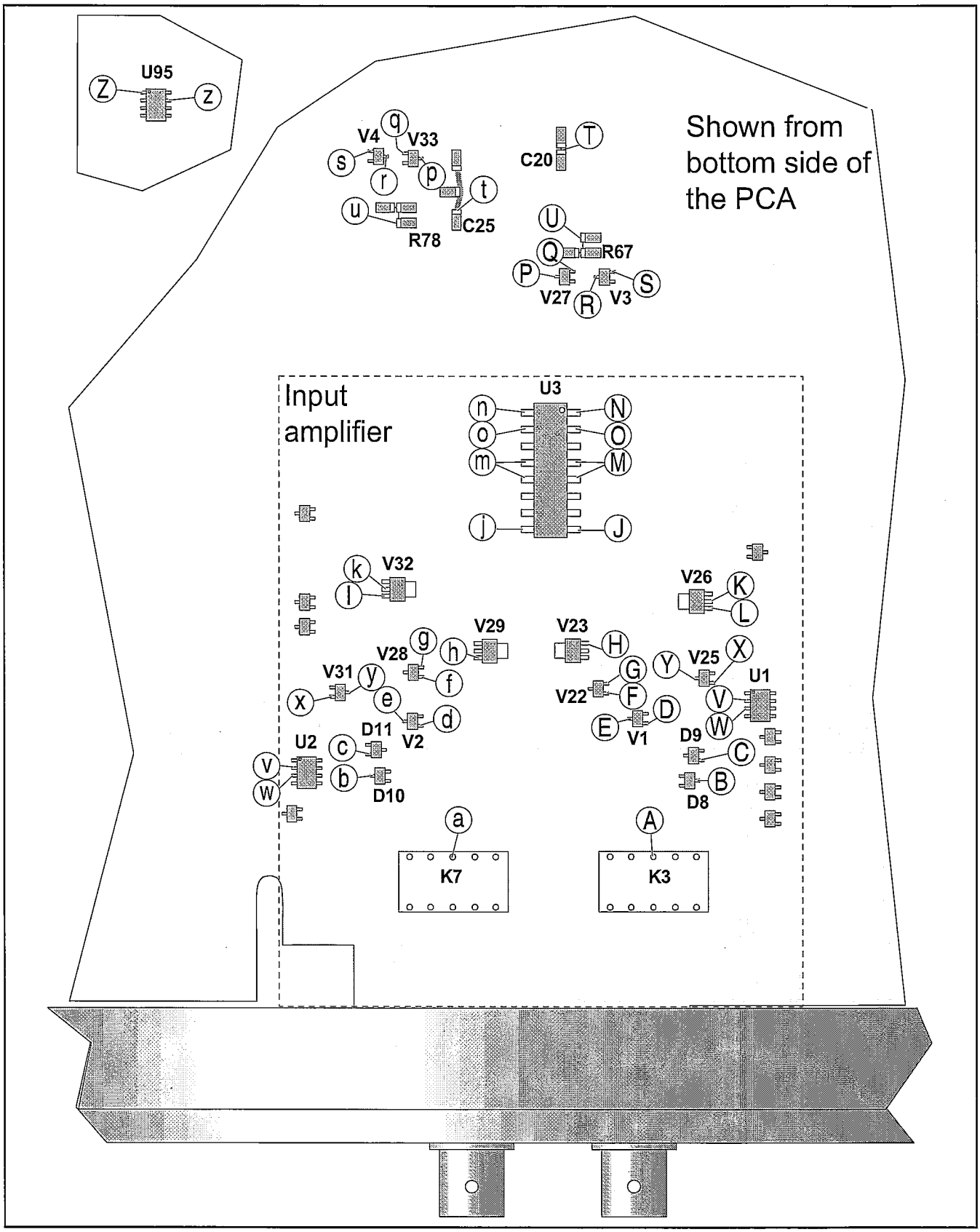


Figure 5-22 *Typical voltages, Input Amplifier.*

Input Amplifier (Functional Level 9)

• *A and B Input Check*

DC levels

- Switch on the counter.
- Press LOCAL/PRESET and ENTER.
- Select Time A-B.
- Deselect AUTO and set the trigger level to -1 V on both inputs.
- Select ATTENUATION A and B to x1.
- Select DC on both inputs.
- Measure the DC voltages according to Figure 5-22 and Table 5-7. Use the DMM with a 10 kΩ resistor in series with the test cable.

Test point	V_{DC}	V_{PP}
A, a	—	0.5
B, b	+2.7	—
C, c	–2.7	—
D, d	+0.4	—
E, e	+1.5	—
F, f	+1.5	—
G, g	+0.8	—
H, h	+0	0.5
J, j	–0.4	—
K, k	–2.8	—
L, l	–3.8	—
M, m	–1.5	—
N, n	–1.7	0.5 (square)
O, o	–0.8	0.5 (square)
P, p	+4.2	1 (square)
Q, q	–2.2	1 (square)
R, r	+3.3	—
S, s	–1.6	—
T, t	+4.2	—
U, u	–2.2	—
V, v	0	0.25
W, w	0	0.25
X, x	+2.7	0.5
Y, y	+1.2	—
Z, z	+2.6	0.5

Table 5-7 *Typical voltages, Input Amplifier.*

AC levels

- Connect a 1000 Hz sine wave signal with an amplitude of 1 V_{p-p} to Input A.
- Set the input amplitude to 1 Vp-p.
- Measure the AC-levels according to Figure 5-22 and Table 5-7. Use the oscilloscope and a 10 MΩ probe.
- Trace the signal from V23 pin E and V29 pin E to PROBE COMP VIEW A and B OUT, P25 pin 5 and 4 at the rear panel.

If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. See also Chapter 4, CIRCUIT DESCRIPTIONS, Input Amplifiers A and B.

• *Prescaler 1.3 GHz, PM 9621*

In all measurements you should use TP4 as ground.

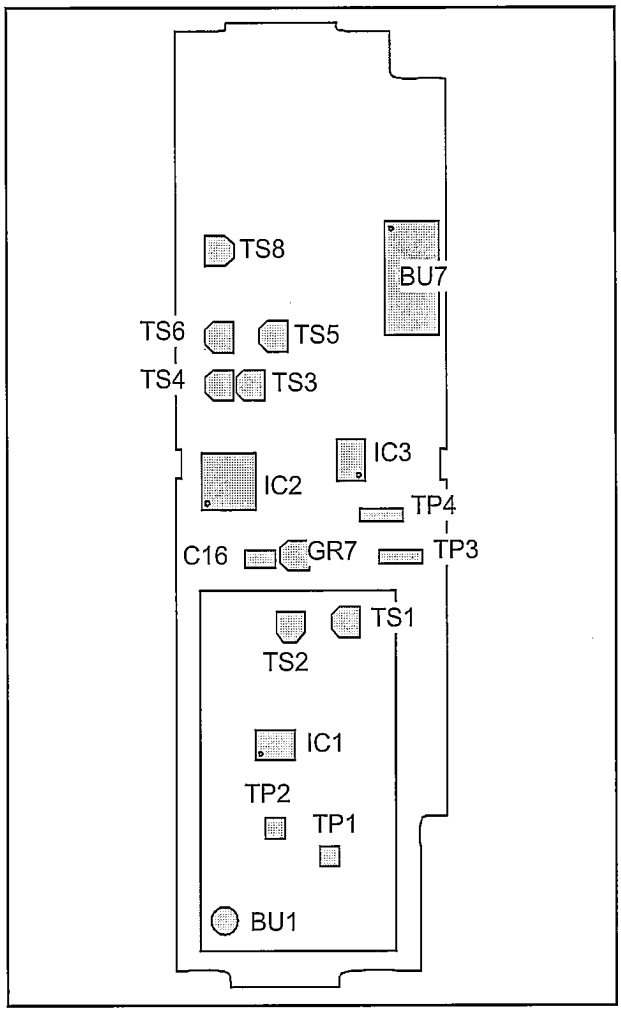


Figure 5-23 *Test points, 1.3 GHz prescaler.*

Sensitivity Check

- Connect the signal generator to the HF input of the counter.
- Check the "Correct sensitivity and counting" levels according to Figure 5-24 to find out which part may have caused the fault. If everything seems all right, the fault is probably caused by the base unit.

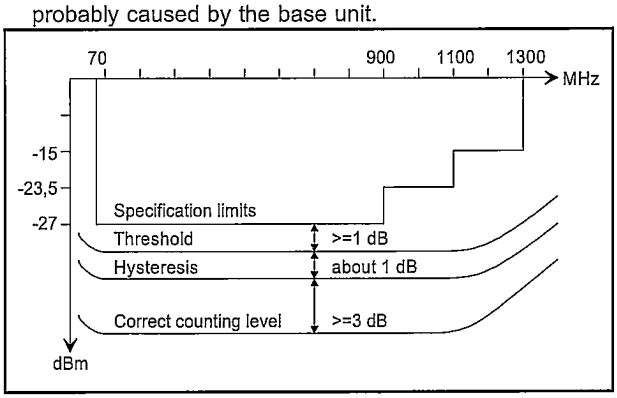


Figure 5-24 *Sensitivity and Counting levels.*

DC-voltages

– Use a DMM to measure the DC-levels according to Table 5-8.

Test point	Measured voltage
IC1 pin 1	≈ 0.9 V
IC1 pin 5	≈ 3.1 V
TS1 pin b	≈ 1.6 V
TS1 pin c	≈ 3.1 V
TS2 pin e	≈ 2.3 V
IC2 pin 2,3	≈ 1.5 V
IC2 pin 6,7	≈ 4.5 V
TS5;c	≈ 4.5 V
TS6;c	≈ 4.5 V
BU7 pin 4	≈ 4.7 V
TP3	≈ 0.57 V

Table 5-8 *DC voltages, PM 9621.*

– Connect the signal generator to the HF input of the counter.
– Set the input frequency to 100 MHz and set the amplitude to -15 dBm, (40 mVRMS).
– Connect the oscilloscope to BU7 pin 4.
– Verify that the amplitude is 800 mV p-p and that the period time is 2.56 µs, (frequency 390 kHz). The DC level should be 3.8 V. If everything seems all right the fault is probably caused by the base unit.
– Connect the DMM to TP3 and TP4 (GND).
– Disconnect the input signal.
– Check that the DC voltage drops ≈ 200 mV.

If this last measurement is OK, you can skip the Overvoltage Protection Control.

Overvoltage Protection Control

– Connect the signal generator to the HF input of the counter.
– Set the input frequency to 100 MHz, and set the amplitude to 13 dBm, (1 VRMS).
– Check the DC voltages according to 0.

Test point	Measured voltage	Comment
TP1	-100 ±50 mV	Correct
TP1	≈ +300 mV	GR3 faulty
TP1	≈ -300 mV	GR4 faulty
TP2	-220 ±100 mV	Correct
TP2	≈ -400 mV	GR11 faulty
TP1 & TP2	≈ ±50 mV	Short circuit in one of GR3, GR4 or GR11

Table 5-9 *DC voltages, Overvoltage protection control, PM 9621.*

– Connect the DMM to IC2 pin 2.
– Check that the DC voltage is ≈ 300 mV.
– Check that the amplitude at IC1 pin 1 is one third of the amplitude at BU1.
– Check that the amplitude at IC1 pin 5 is ≈ 300 mVp-p.
– Check that the amplitude at TS1 collector and TS2 emitter is ≈ 500 mVp-p.

Level Detector Control

– Disconnect the signal generator from the counter.
– Check the level detector according to the table below.
– Connect the signal generator to the HF input of the counter.
– Set the input frequency to 100 MHz and the amplitude to 13 dBm, (1 VRMS).
– Check the level detector according to Table 5-10.

Test point	Without input signal	With input signal
GR7, C16	≈ 320 mV	≈ 10 mV
IC3 pin 3	≈ 570 mV	≈ 370 mV
IC3 pin 1, 6	≈ 2.2 V	< 0.1 V
IC3 pin 5	≈ 2.07 V	≈ 2.1 V
IC3 pin 7	< 0.8 V	≈ 4.4 V
TS8;b	≈ 4.9 V	≈ 4.2 V
BU7 pin 4	≈ 4.7 V	≈ 3.8 V

Table 5-10 *DC voltages, Level detector, PM 9621.*

Divider and Differential Stage Control

– Connect the oscilloscope to IC2 pins 6 and 7.
– Check that the amplitude is 800 mVp-p and that the period time is 2.56 µs, (frequency 390 kHz). The DC level is 4.5 V.
– Connect the oscilloscope to TS3;b and TS4;b.
– Check that the amplitude is 800 mVp-p and that the period time is 2.56 µs, (frequency 390 kHz). The DC level is 3.8 V.
– Connect the oscilloscope to TS5;c and TS6;c.
– Check that the amplitude is 800 mVp-p and that the period time is 2.56 µs, (frequency 390 kHz). The DC level is 4.5 V.

Signal Measurement

– Connect the signal generator to the HF input of the counter.
– Connect the Y-input of the oscilloscope to TP3 and TP4 (GND).
– Connect the X-input of the oscilloscope to the horizontal output of the generator.
– Set the frequency range of the generator to 70-1300 MHz.
– Set the amplitude to -15 dBm, (40 mVRMS).
– Figure 5-25 shows the typical frequency curve of the prescaler.

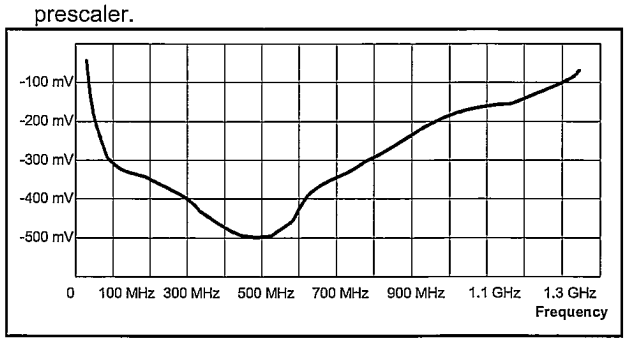


Figure 5-25 *Typical Frequency Curve PM9621.*

• *Prescaler 2.7 GHz, PM 9624*

See Chapter 2, Performance Check, for verification.

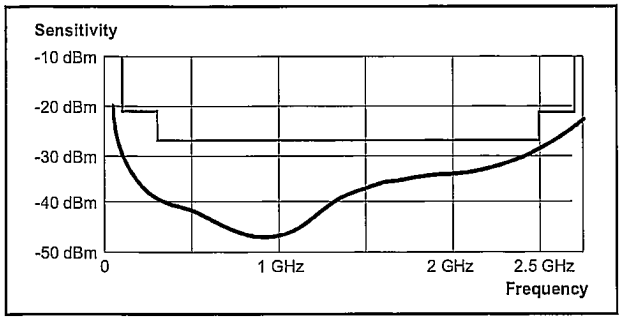


Figure 5-26 *Specified and typical sensitivity of input C with option PM 9624.*

This prescaler cannot be repaired in a local workshop. It must be sent to a Fluke Service Center, who will transfer the prescaler to the factory for repair.

• *Prescaler 4.2 GHz, PM 9625B*

See Chapter 2, Performance Check, for verification.

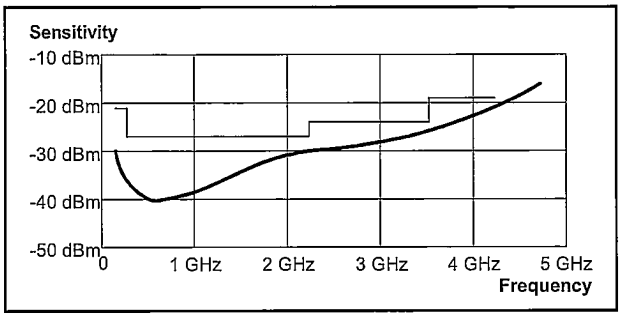


Figure 5-27 *Specified and typical sensitivity of input C with option PM 9625B.*

This prescaler cannot be repaired in a local workshop. It must be sent to a Fluke Service Center, who will transfer the prescaler to the factory for repair.

• *Prescaler 4.5 GHz, PM 9625*

See Chapter 2, Performance Check, for verification.

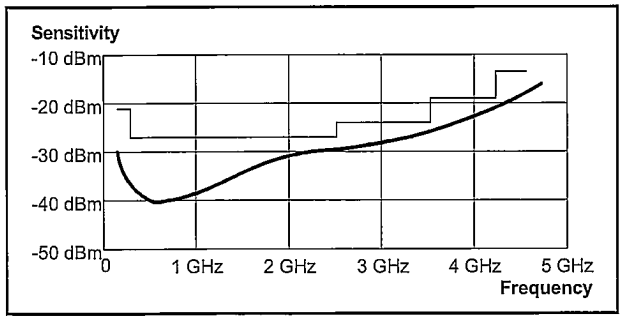


Figure 5-29 *Specified and typical sensitivity of input C with option PM 9625.*

This prescaler cannot be repaired in a local workshop. It must be sent to a Fluke Service Center, who will transfer the prescaler to the factory for repair.

GPIB interface and Analog output (Functional Level 10)

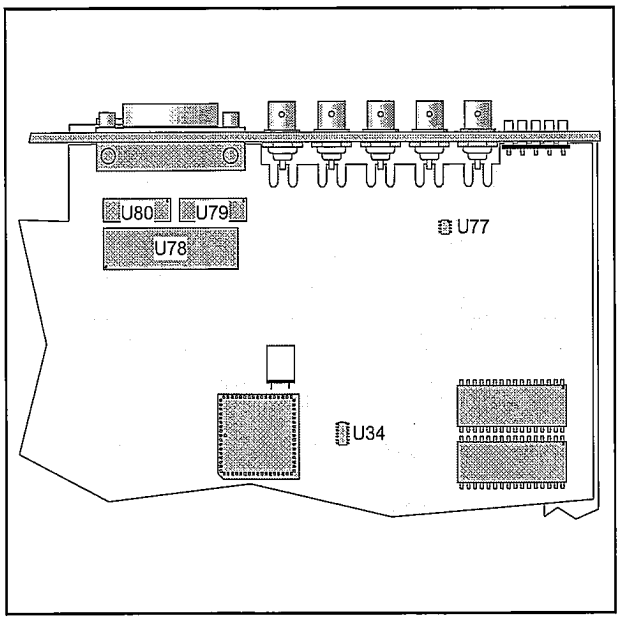


Figure 5-28 *Component layout, GPIB interface.*

– Set the oscilloscope to 2 V/div and 10 ms/div.
– Run the Analog out 1 test, Test 10.

The µ-controller generates a pulse width modulated signal with a variable duty cycle. This PWW signal is converted by U34 to a sawtooth signal of approximately 20 Hz. U77 makes a DC voltage in the range 0 to 4.98 V of the sawtooth and feeds it to the analog output on the GPIB interface.

NOTE: U34, and U77 are located at the bottom side of the main PCA.

Trace the signal from U6 pin 39 on the main board to ANALOG OUT, J3 at the rear panel.

– Use P5 on the main board to trigger the oscilloscope.
– Run the ANALOG OUT 2 test, Test 11.
– The analog output now outputs a DC voltage that can be controlled by pressing the UP/DOWN keys.

0 = min value = 0 V

255 = max value = 4.98 V

– Connect an IBM PC or compatible, equipped with a PM 2201, GPIB interface or equivalent and its software, to the interface in the counter.
– Insert the floppy disc labeled: Test and Calibration program for PM 6681. This test program is included in this Service manual.
– Change to the drive where the test floppy is inserted.
– Type GPIBTEST and press enter to start to program.

All instructions needed to run the program are supplied by the program itself.

NOTE: This test program does not test the analog output.

If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. See also Chapter 4, Circuit Descriptions, GPIB-Interface.

Safety Inspection and Test After Repair

General Directives

After repair in the primary circuits, make sure that you have not reduced the creepage distances and clearances.

Before soldering, component pins must be bent on the solder side of the board. Replace insulating guards and plates.

Safety Components

Components in the primary circuits are important to the safety of the instrument and may only be replaced by components obtained from your local Fluke organization.

Check the Protective Ground Connection

Visually check the correct connection and condition and measure the resistance between the protective lead at the plug and the cabinet. The resistance must not be more than 0.5 Ω. During measurement, the power cord should be moved. Any variations in resistance shows a defect.

Chapter 6

Calibration Adjustments

Introduction

Required Test Equipment

Type	Performance	Model No
DMM	5 full digits	PM 2534
Counter		PM 6669
DC source	5 V	Philips PE 1536
LF-synthesizer	10 kHz/20 Vpp	PM 5193 S
PC incl. CRC GPIB interface		-**
Interpolator Calibration program		** (incl. in this manual)
Pulse Generator	125 MHz/2ns	PM 5786 (PM 5781**)
Signal generator	1300 MHz	6062A
Sampling oscilloscope		
FET probe		
Passive probe	10:1 <1.5 pF	PM 8926
Terminator	50 Ω/1 W	PM9585 or Y9103
Attenuator	20 dB	PM 9591 or Y9102
Power splitter	50 Ω/4W	PM 9584
T-piece		PM 9067; Y9107
10 MHz reference	$1x10^{-7}$	PM 9691
10 MHz reference	$1x10^{-9}$	PM 6681R or PM6685R*
BNC-BNC cables		
Insulated screwdriver		

Table 6-1 *Required Test Equipment.*

* For adjustment of Oven Oscillators only.

** PM 5781required for Interpolator calibration adjustment.

Preparation

WARNING: Live parts and accessible terminals which can be dangerous to life are always exposed inside the unit when it is connected to the line power. Use extreme caution when handling, testing, or adjusting the counter.

Before beginning the calibration adjustments, power up the instrument and leave it on for at least 60 minutes to let it reach normal operating temperature.

Power Supply

CAUTION: If you adjust the +5V trimmer you have to adjust the complete instrument.

• *Setup*

– Connect the counter to the line power.
– Switch on the counter.
– Press PRESET, then press ENTER.

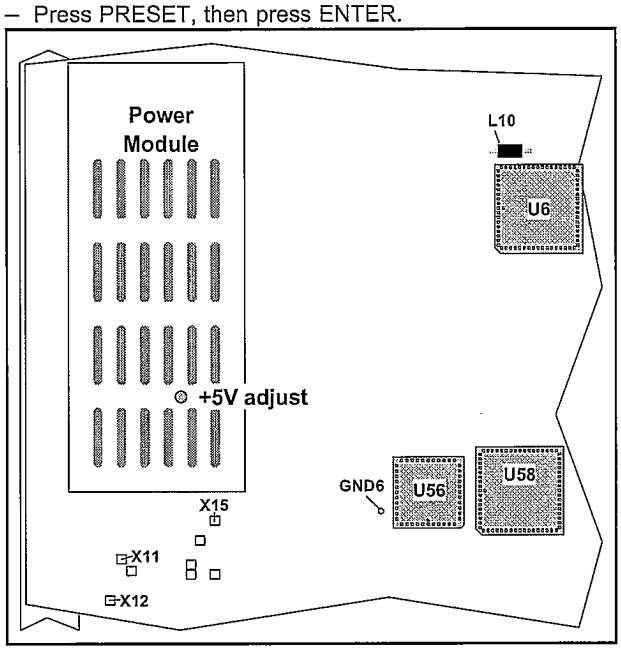


Figure 6-1 *Test points and trimmer for the Power Supply.*

• *Adjustment*

– Connect the DMM to test points L10 and GND6, see Figure 6-1.
– Adjust the +5V trim potentiometer R446=+5V adjust in the power supply using an insulated screwdriver, until the DMM reads +5.000 ±0.001 V.
– Check that the voltage at the test points X15=+5 and GND6 is +5.00 ±0.05 V.
– Check that the unregulated voltage from the power supply at test points X11=+15 and GND6 is about +18 V.
– Check that the unregulated voltage from the power supply at test points X12=–9 and GND6 is about –8 V.

Crystal Oscillators

16 MHz Oscillator

– Connect the counter via a probe to the test point P7 and GND5.
– Check that the measured frequency is 8 MHz ±100 Hz.

External Reference Input Multiplier

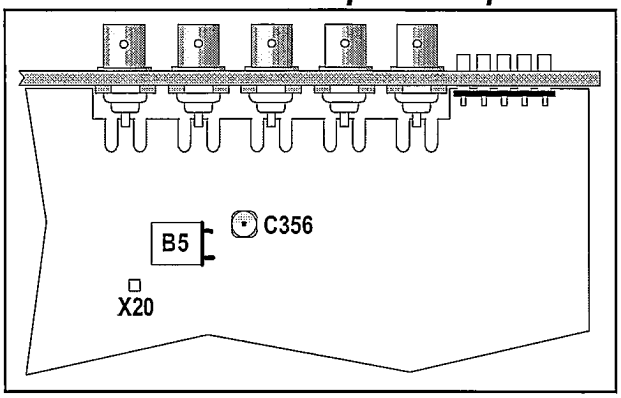


Figure 6-2 *Trimmers for the 10 MHz Frequency Multiplier.*

• Setup

PM 6681	Function	EXT REF
LF synthesizer	Amplitude	1 V Sinus
	Frequency	1 MHz
Sampling Oscilloscope	Time	200 µs/div.
	Setting: A	1 V/div.,50 Ω,DC

Table 6-2 *10 MHz Multiplier setup.*

– Connect the LF synthesizer to the REFERENCE INput at the rear of the PM 6681 via a 50 Ω attenuator.
– Connect the Sampling Oscilloscope to the test point X20. (Use a FET probe).
– Adjust C356 to maximum amplitude. See Figure 6-2.

Standard Oscillator

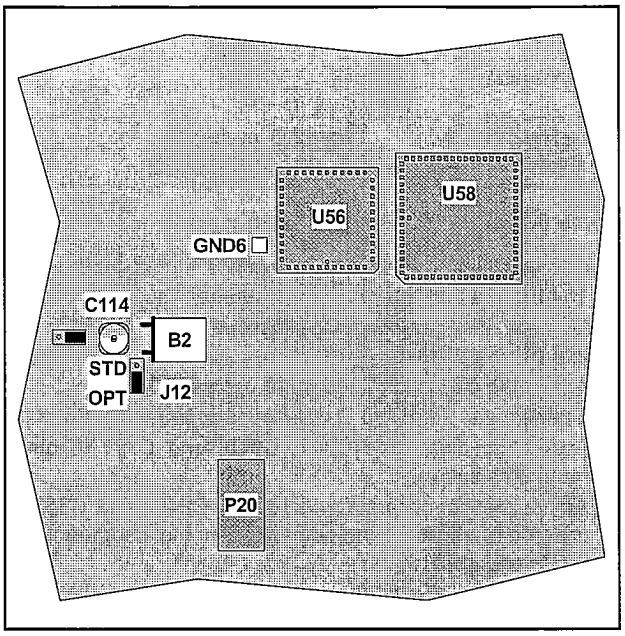


Figure 6-3 *Trimmers for the reference oscillator frequency.*

• Setup

– Connect the counter to the 10 MHz OUTput at the rear of the PM 6681.

The adjustment should preferably be made at an ambient temperature of +25°C.

• Adjustment

– Adjust C114=STD OSC ADJ until the counter reads 10 MHz +2 Hz. See Figure 6-3.

100 MHz Frequency Multiplier

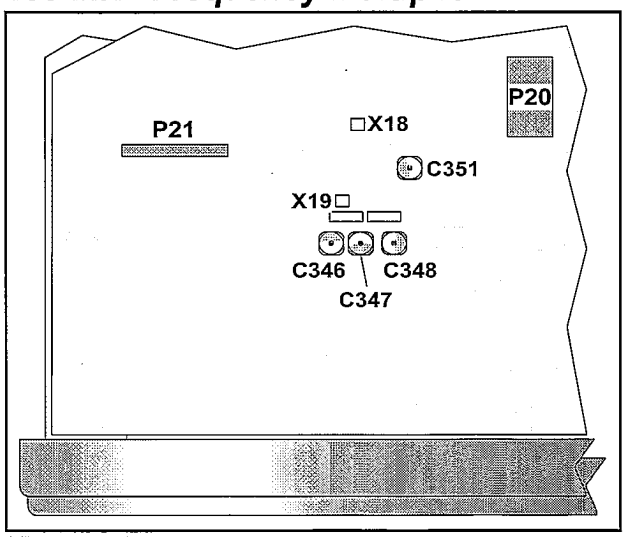


Figure 6-4 *Trimmers for the 100 MHz Frequency Multiplier.*

• Setup

PM 6681	Function	EXT REF
LF synthesizer	Amplitude	1 V Sinus
	Frequency	10 MHz
Sampling Oscilloscope	Time	200 µs/div.
	Setting: A	1 V/div.,50 Ω,DC

Table 6-3 *100 MHz Multiplier setup.*

- Connect the Sampling Oscilloscopes trigger input to the 10 MHz OUT at the rear of the counter.
- Connect the Sampling Oscilloscope via a probe to the test point X19. See Figure 6-4.
- Adjust the capacitor C346 to 10 cycles/100 ns.
- Connect the Sampling Oscilloscope to the test point X18.
- Adjust the capacitors C347, C348, and C351 to maximum amplitude.
- Adjust the capacitors C346, C347, C348, and C351 to maximum amplitude in sequence until maximum amplitude is reached at X18.
- Connect the LF-synthesizer with a 10 MHz reference to the EXT-REF input of the counter.
- Select EXT REF.
- Change the input frequency ±1 kHz.

If the amplitude is varying with the frequency the capacitors C347 and C348 has to be adjusted again. Begin to adjust the the amplitude at 10 MHz +1 kHz.

Eventuality C346 has to adjusted as well.

Optional TCXO, PM 9678B

• Setup

- Connect the counter to the line power.
- Switch on the counter.
- Press PRESET, then press ENTER.
- Connect the 10 MHz reference to the A input of the counter.

The adjustment should preferably be made at an ambient temperature of +23°C.

• Adjustment

- Adjust the trim capacitor C1 on the optional oscillator until the counter reads 10 MHz ±1 Hz. See Figure 6-5.

Optional Oven Oscillators, PM 9690 and PM 9691

• Setup

- Connect the counter to the line power.
- Switch on the counter.
- Press PRESET, then press ENTER.

Oscilloscope	Time	100ns/div.

Table 6-4 *Optional oscillator setup.*

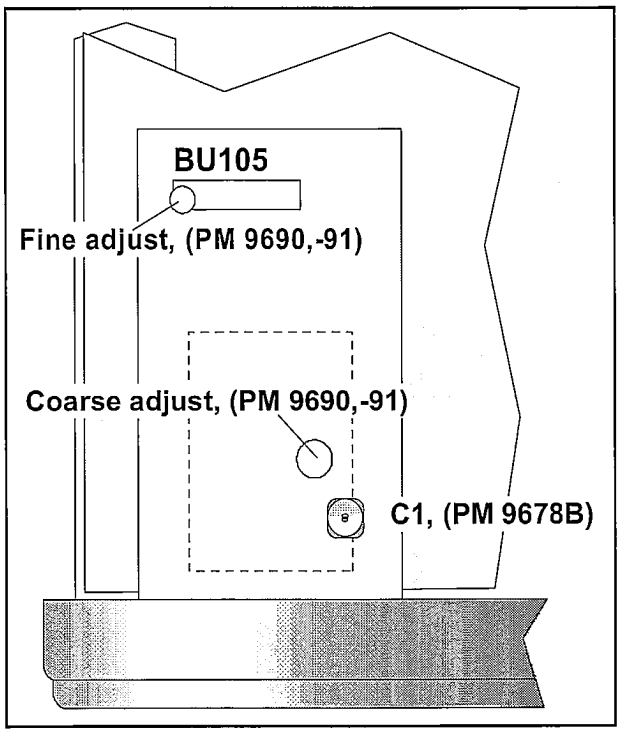


Figure 6-5 *Trimmers for the optional oscillator frequency.*

The adjustment should preferably be made at an ambient temperature of +23°C.

The oscillator must have been operating continuously for 48 hours before any adjustment is made.

- Connect the 10 MHz reference signal of the PM 668XR to EXT TRIG of the oscilloscope.
- Connect the 10 MHz out of the counter to the A-input of the oscilloscope.

• Adjustment

- Adjust the FINE trimmer on the oscillator until the waveform moves with a velocity of a maximum of 1 div/10s (0.1 Hz). See Figure 6-5.

If the adjustment is too narrow, proceed as follows:

- Set the FINE trimmer fully clockwise.
- Remove the two screws holding the oscillators text plate.
- Use a pair of tweezers to remove the small plastic cylinder beneath the text plate.
- Connect an external counter to the 10 MHz OUT socket of the counter to be adjusted.
- Adjust the COURSE trimmer until the display reads 10000003 Hz on the external counter.
- Adjust the FINE trimmer until the display reads 10000000 Hz on the external counter.
- Reinstall the plastic cylinder and the text plate to the oscillator.

Adjust the FINE trimmer on the oscillator until the waveform moves with a velocity of a maximum of 1 div/10s (0.1 Hz).

Interpolator

NOTE: This adjustment has only to be performed if the timer/counter has lost it's calibration information, (that is if the counter displays `ZCaL.LOStZ`*, or if you have made any repairs in the interpolator circuits.*

• Setup

– Connect the Pulse Generators output A to the input A of PM 6681.
– Connect the LF-synthesizers to the EXT INput of the Pulse Generator.
– Connect a 10 MHz (aging at least 10^{-8}) reference to the reference input of PM 6681 and the synthesizer.
– Connect the the GPIB connectors of the PM 6681, LF-synthesizer, and Pulse Generator to the PC;s GPIB card.

NOTE: The timer/counter, synthesizer, and the pulse generator should not have the same GPIB address, none of them should have address 0 or 30, (this is used by the PC).

• Adjustment

– Turn on the *timer/counter*, the synthesizer, and the pulse generator.

If the *timer/counter* shows a flashing `ZCal.lostZ`, press the preset button until this message disappears.

NOTE: The calibration should be done when the counter has been on for more than 20 minutes. If you start the calibration program before 20 minutes has passed since power on, the program will wait the required time.

– Insert the discette labeled "Test and Calibration program for PM 6681", into the $3^1/_2$" disc-drive on the PC.
– Start the calibration program from the DOS command prompt with the command "[path]CALVER81". Supposing you use the A: drive, this might look like:

C:\ >a:CALVER81

The first displayed screen on the PC will show you the needed hardware and software to run the calibration program. It also shows the bus addresses the different instrument must be set to.

– Press ENTER when you are ready to begin the calibration.
– Now you shall enter the different GPIB addresses for the instruments involved.
– Type the serial number of the counter under test and press ENTER.

Now you will be asked if you want to calibrate the counter. The calibration will take between 20 and 60 minutes to complete. (If you answer no (n) on this question you will be asked if you want to verify the calibration of the interpolators. The verification will only take a few minutes.)

The program will attempt calibration using a number of different input signals, and will check the result, choosing for the final calibration the best result achieved.

After the calibration is completed the best calibration parameter will be stored in the counters battery backuped RAM. A printout of the calibration result will also be sent to LPT1 of the PC. The printout will look as shown below:

NOTE: Even though the specification says 50ps the system does not accept more han 40ps. This limit is set to ensure that the spec should be fulfilled over the whole temperature range.

```
**********************************************************************************
* PM6681 TEST DATA                                    TEST PROGRAM VERSION 1.0   *
**********************************************************************************
* DATE: 94-06-14       TIME: 12:51:25                                            *
* IDENTITY CODE: SM 999                                                          *
* TASK: VERIFICATION OF INTERPOLATOR CALIBRATION                                 *
**********************************************************************************
* Identification Query:                                                          *
* PHILIPS, PM6681, 0, MAIN X1.02  Mar 08 1994 13:53:01 / GPIB X1.13  Mar 0       *
* PM9626,0                                                                       *
**********************************************************************************
* T (°C) CAL PLS (s)  MIN SDEV MEAN SDEV MEAN SPEC  MAX SDEV  MAX SPEC P/F       *
**********************************************************************************
     +22   4.29E-009 2.16E-011 2.91E-011 3.00E-011 3.99E-011 4.00E-011  P
**********************************************************************************
```

Calibrated at temperature	Pulse used to calibrate	Minimum value measured by the system	Mean value measured by the system	Mean value accepted by the system	Maximum value measured by the system	Maximum value accepted by the system	Pass/ Fail

All of these values are results of standard deviation measurements of pulse widths in the range 4 to 50 ns (in 2 ns steps). For each pulse width 2000 samples are taken.

Input Amplifier

- *Setup*

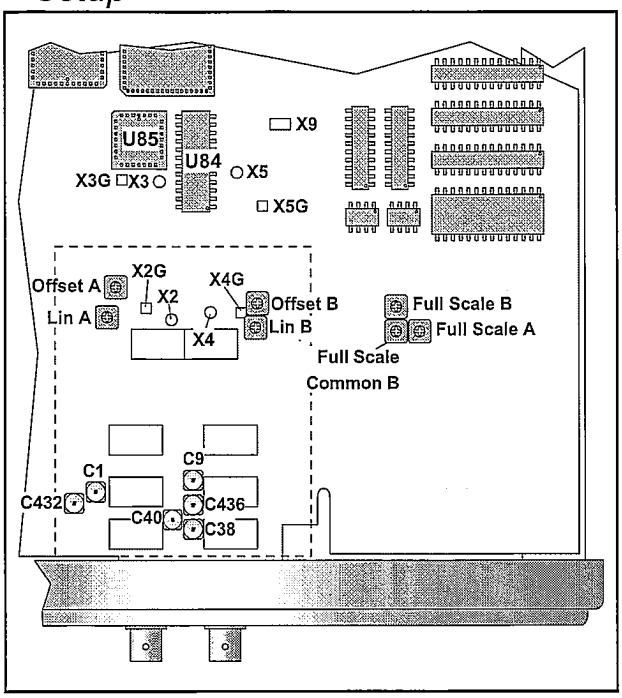


Figure 6-7 *Test points and trimmers for the Input amplifiers.*

Step Response

- *Setup*

PM 6681	Function	TIME A–B
	Input A+B	50 Ω/DC/Manual trigger levels
	Attenuation	X1
Pulse Generator	Amplitude	4 V
	Pulse Period	1 ms
Sampling Oscilloscope	Time	100 µs/div.
	Setting: A	10 mV/div. (10:1 <1.5 pF passive probe),DC

Table 6-5 *Step Answer setup.*

NOTE: The adjustment must be made at an ambient temperature of +25°C.

– Connect the Pulse Generator to the A input of the counter (B input) via the T-piece.

NOTE: It is of most importance that the output pulses from the pulse generator does not tilt more that 0.1% of the pulse amplitude.

– Connect the channel A of the oscilloscope via a probe to the other output from the T-piece, see Figure 6-6.
– Adjust the amplitude of the oscilloscope until the pulse is 8 divisions high.
– Adjust the probe until the pulse is absolutely flat.

- *Adjustment*

Channel A

– Connect the probe to test point X2.
– Adjust R167=LIN A and C40=1X A until the signal is absolutely flat.

Channel B

– Connect the probe to test point X4.
– Adjust R168=LIN B and C38=1X B until the signal is absolutely flat.

- *Setup*

PM 6681	Function	VOLT A MAX/MIN
	Input A+B	50 Ω/DC/Manual trigger level
	Measuring time	80 ns
	Attenuation	1X
Sampling Oscilloscope	Amplitude	10 mV/div on channel B (10:1 <1.5 pF passive probe)
	Time	5 µs/div
Pulse Generator	Amplitude	4.8 V
	Pulse Period	100 µs
	Rise/Fall time	3 ns
	Pulse shape	Symmetrical/positive pulse

Table 6-6 *10X Attenuator setup.*

– Press AUX MENU.
– Select `Auto Lo` .and press ENTER.
– Type 1000 on the numeric keypad and press ENTER.
– Connect CLOCK OUT from the pulse generator to TRIGG IN on the osilloscope.
– Connect the Pulse generator to the A input via a T-piece.
– Connect the oscilloscope to the other end of the T-piece and check that the base- and top line of the pulse is absolutely flat.

- *Fine adjustment*

At the first hand the X1 attenuation should be best adjusted.

NOTE: It is of most imporance that the screewdriver does not contain any kind of magnetic material.

1X Attenuator channel A

NOTE: Four digits on the display.

– Connect the probe to test point X2. For trimmers and test points see Figure 6-6.
– Adjust C40=1X A until the tilt of the top line is 0.3 V. See Figure 6-7.

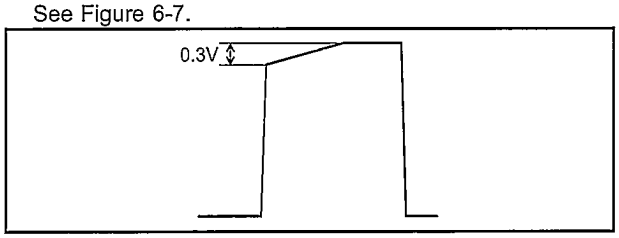


Figure 6-6 *The tilt of the top line is 0.3 V.*

– Remove the probe.
– Read the counters display.
– Adjust C40=1X A until the displayed value has increased 5 to 10 mV.

10X Attenuator channel A

NOTE: Three digits on the display.

– Select 10X on input A.
– Connect the probe to test point X2. For trimmers and testpoints see Figure 6-6.
– Adjust C1=10X A and C432 until best possible pulse, without any overshoots or undershoots.
– Adjust C1=10X A until the tilt of the top line is 0.3 V. See Figure 6-7.
– Remove the probe.
– Read the counters display.
– Adjust C40=10X A until the displayed value has increased 10 to 30 mV.
– Shift between 1X and 10X and check that the displayed value does not differ more than ±50 mV.

1X Attenuator channel B

NOTE: Four digits on the display.

– Connect the probe to test point X4. For trimmers and testpoints see Figure 6-6.
– Adjust C38=1X B until the tilt of the top line is 0.3 V. See Figure 6-7.
– Remove the probe.
– Read the counters display.
– Adjust C38=1X B until the displayed value has increased 5 to 10 mV.

10X Attenuator channel B

NOTE: Three digits on the display.

– Select 10X on input B.
– Connect the probe to test point X4. For trimmers and testpoints see Figure 6-6.
– Adjust C9=10X B and C436 until best possible pulse, without any overshoots or undershoots.
– Adjust C9=10X B until the tilt of the top line is 0.3 V. See Figure 6-7.
– Remove the probe.
– Read the counters display.
– Adjust C38=10X B until the displayed value has increased 10 to 30 mV.
– Shift between 1X and 10X and check that the displayed value does not differ more than ±50 mV.

Sensitivity

• Setup

PM 6681	Function	DUTY F A
	Input A+B	50 Ω/AC/Manual trigger levels
	Attenuation	1X
	Trigger levels	0 V
	Measuring time	100 ms
LF synthesizer	Frequency	1 kHz Sinus or triangle
	Amplitud	500 mV pp before the attenuator
Oscilloscope	Amplitude	50 mV/div (10:1 probe)
	Time	200 µs/div

Table 6-7 *Sensitivity setup.*

– Connect the LF synthesizer via an 20dB attenuator to input A.
– Check with the oscilloscope that the signal at the input of the counter is clean and real sinus or triangle.
– Adjust the resistor R18=OFFSET A until the counter shows 0.500 ±0.001.
– Connect the LF synthesizer via the 20dB attenuator to input B.
– Press SWAP.
– Adjust the resistor R44=OFFSET B until the counter shows 0.500 ±0.001.

Trigger Levels

• Setup

PM 6681	Function	FREQ A
	Input A+B	1MΩ/DC/Manual trigger levels
	Attenuation	1X
	Trigger levels	5 V
	Measuring time	80 ns
DC source	Amplitude	5.0 V ±50 mV.

Table 6-8 *Trigger Levels setup.*

• Adjustment

• Channel A

– Connect a stable DC voltage to the A input of the counter via a T-piece. See Figure 6-8.
– Connect a DMM to the other end of the T-piece.

NOTE: Use coaxial cables to avoid signal interferance.

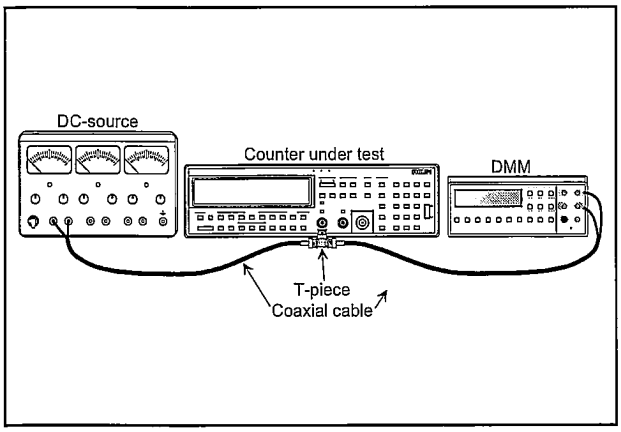


Figure 6-9 *Connect a stable DC voltage to the A input of the counter.*

- Press AUX MENU.
- Select `AU.COdES` and press ENTER.
- Type 23.1 on the numeric keypad and press ENTER.
- Set the measuring time to 80 ns.
- Press STAT and select MEAN.
- Type 10 on the numeric keypad and press ENTER.
- Select 1X attenuation.

NOTE: If it is not possible to select 1X attenuation R308 has to be adjusted.

- Adjust R308=FULL SCALE A until the counter displays the same value as the DMM ±1 mV.

• Common

- Select COMMON.
- Press SWAP.
- Adjust R311=FULL SCALE COMMON B until the counter displays the same value as the DMM ±1 mV.

• Channel B

- Move the the DC source and the DMM to the B input.
- Deselect COMMON and SWAP.
- Adjust R331=FULL SCALE B until the counter displays the same value as the DMM ±1 mV.

Analog output

• Setup

PM 6681	Input A	50 Ω/AC/Manual trigger levels
	Attenuation	X1
LF synthesizer	Amplitude	1 Vpp*
	Frequency	1000.01 Hz square wave

Table 6-9 *GPIB interface setup.*

* The output amplitude mentioned is the set amplitude; it is only valid for an open output of the synthesizer.

• Adjustment

- Connect the DMM to the BNC connector ANALOG OUTput at rhe rear of the PM 6681.
- Activate the analog output.
  - Select AUX MENU.
  - Press SELECT/SET until the display reads `ANALOG OUt.`
  - Press ENTER.
  - Press SELECT/SET to select ON.
  - Press ENTER.
  - Type 0.001 ENTER via the keyboard.
- Connect the LF synthesizer to the A input of the counter.

The counter should read 1000.0xxxxx Hz.

- Adjust the trimmer ZERO=R384 (see Figure 6-9) until the output voltage is 0 V ±1 mV.

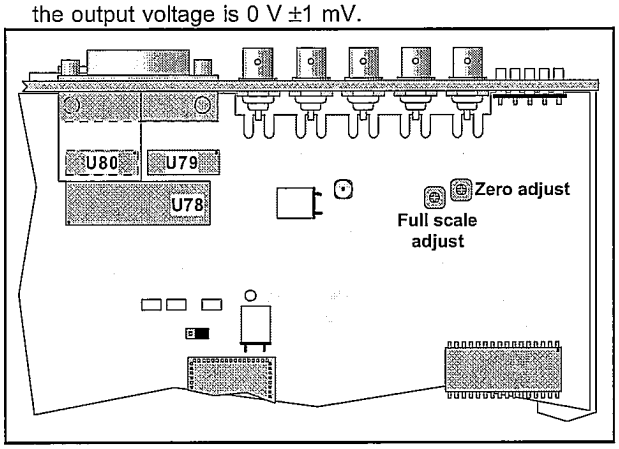


Figure 6-8 *Trimmers for the Analog output.*

- Set the LF synthesizer to 999.90 Hz/1 Vpp square wave.

The counter should read 999.9xxxxx Hz.

- Adjust the trimmer FULL SCALE=R381 (see Figure 6-9) until the output voltage is 4.980 V ±3 mV.
- Set the LF synthesizer to 100.0 Hz/1 Vpp square wave.

The counter should read 100.0xxxxx Hz.

- Check that the output voltage is 500 mV ±5 mV.

1.3 GHz HF-input, PM 9621

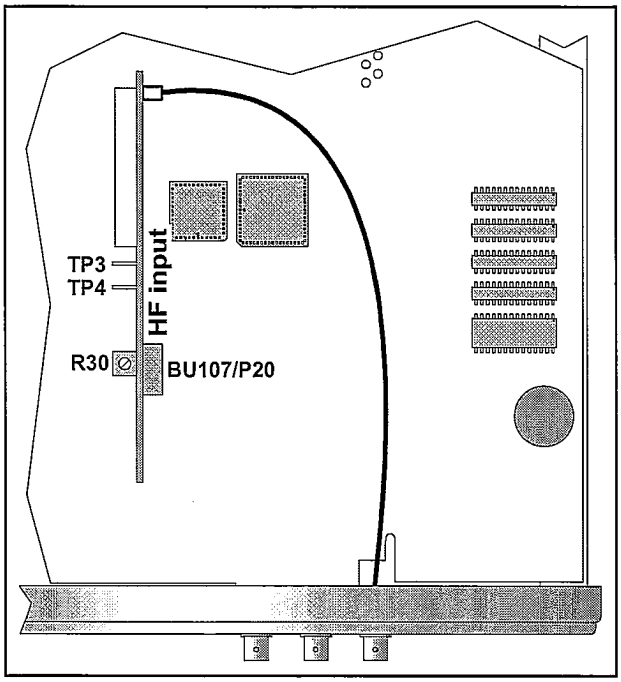


Figure 6-11 *Test points and trimmers for the 1.3 GHz HF-input.*

NOTE: Before beginning any adjustments, the HF input must have been in operation for at least one minute, to let it reach normal operating temperature.

• Setup

– Connect the counter to the line power.
– Switch on the counter.
– Press PRESET, then press ENTER.

PM 6681	Input C	FREQ C
Signal generator	Frequency	900 ±25 MHz
	Amplitude	7.5 ±0.5 mV RMS

Table 6-10 *1.3 GHz HF-input setup.*

– Connect the signal generator to the HF-input.

• Adjustment

– Turn the potentiometer R30 fully counterclockwise. See Figure 6-10.
– Check that the GATE indicator stops blinking.
– Turn R30 slowly clockwise until the GATE indicator starts blinking.

The input frequency, 900 ±25 MHz will now be displayed.

2.7 GHz HF-input, PM 9624

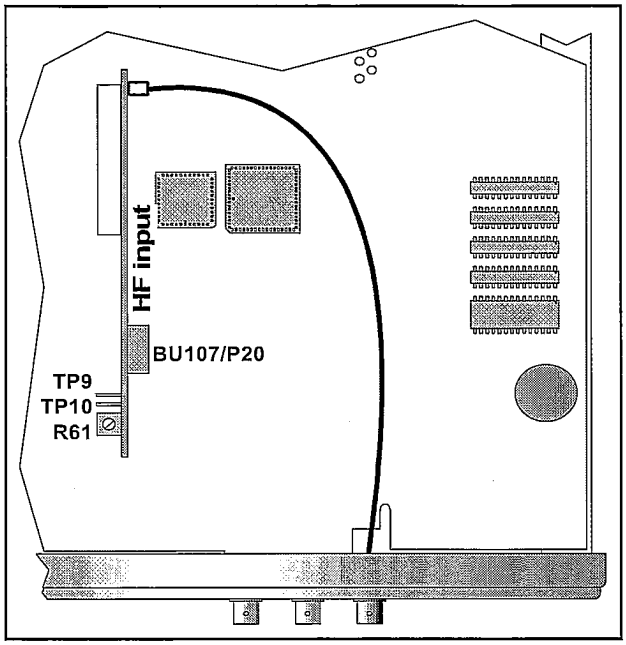


Figure 6-10 *Test points and trimmers for the 2.7 GHz HF-input.*

NOTE: Before beginning any adjustments, the HF input must have been in operation for at least one minute, to let it reach normal operating temperature.

• Setup

– Connect the counter to the line power.
– Switch on the counter.
– Press PRESET, then press ENTER.
– Connect the signal generator to the HF-input.

PM 6681	Input C	FREQ C
Signal generator	Frequency	1000 ±25 MHz
	Amplitude	5.9 ±0.5 mV RMS

Table 6-11 *HF-input setup.*

• Adjustment

– Turn the potentiometer R61 fully counterclockwise. See Figure 6-11.
– Check that the GATE indicator stops blinking.
– Turn R61 slowly clockwise until the GATE indicator starts blinking.

The input frequency, 1000 ±25 MHz shall now be displayed.

4.2 GHz HF-input, PM 9625B

It is not possible to make any adjustments to the PM 9625B.

Therefore, if you suspect any faults, we recommend you to send the unit to the factory for repair.

Contact your local Philips or FLUKE service center.

To verify the 4.2 GHz HF input a sweep frequency synthesizer, (Wiltron 6717B-20) is needed.

4.5 GHz HF-input, PM 9625

It is not possible to make any adjustments to the PM 9625.

Therefore, if you suspect any faults, we recommend you to send the unit to the factory for repair.

Contact your local Philips or FLUKE service center.

To verify the 4.5 GHz HF input a sweep frequency synthesizer, (Wiltron 6717B-20) is needed.

Chapter 7

Replacement Parts

Introduction

Standard Parts

Electrical and mechanical replacement parts can be obtained through your local Philips or Fluke organization or representative. However, many of the standard components can be obtained from other local suppliers. Before purchasing or ordering replacements parts, check the parts list for value, tolerance, rating, and description.

If the value of the physical component differs from what is described in the parts list, you should always replace the part with the same value as originally mounted.

NOTE: Physical size and shape of a component may affect the performance of the instrument, particularly at high frequencies. Always use direct replacements unless it is known that a substitute will not degrade the performance of the instrument.

Special Parts

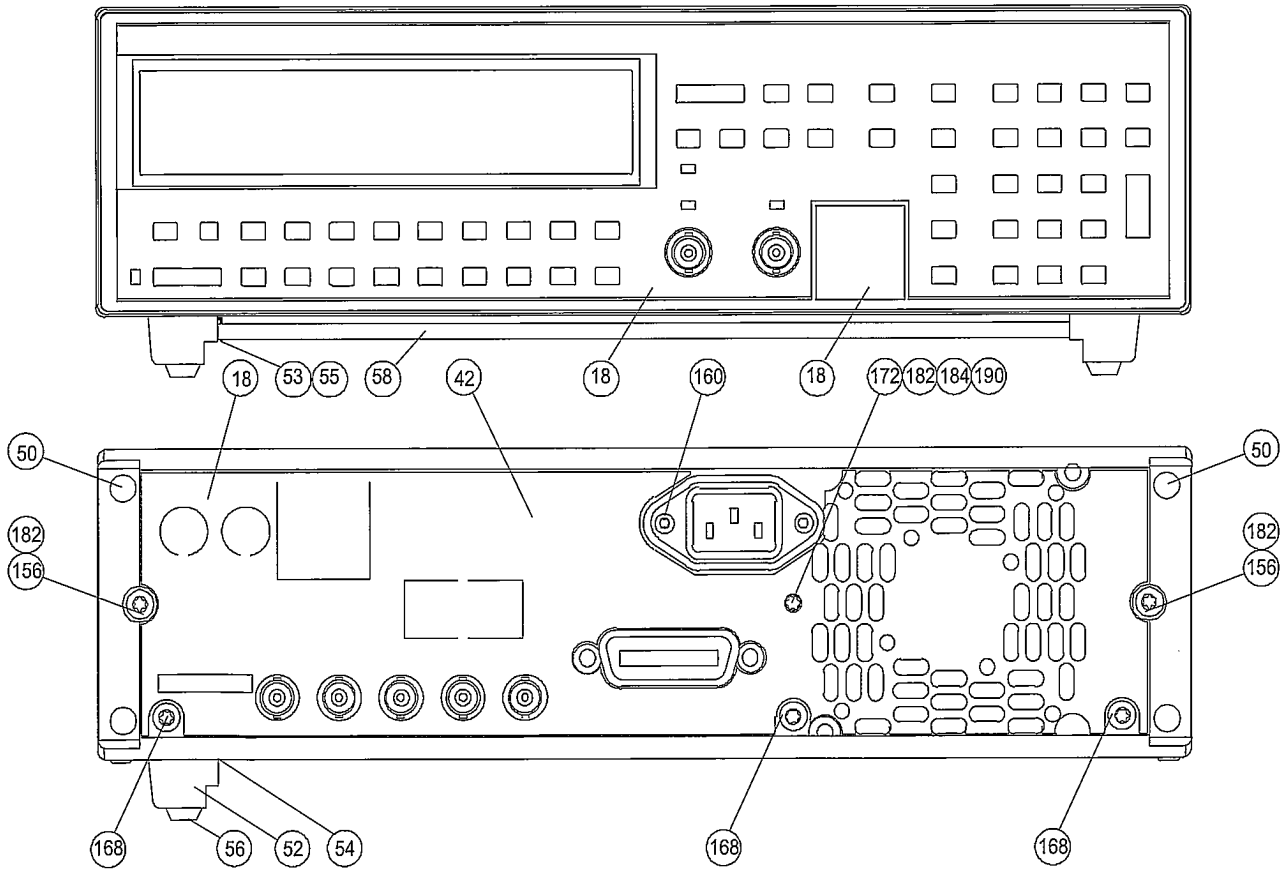
In addition to standard electronic components, the following special components are used:

- Components that are manufactured or selected by Philips to meet specific performance requirements.
- Components that are important for the safety of the instrument.

Both type of components may be replaced only by components obtained through your local Philips or Fluke organization.

The abovementioned parts are 'Recommended Replacement Parts' and are marked with an 'R' in the ☆ column of the parts list.

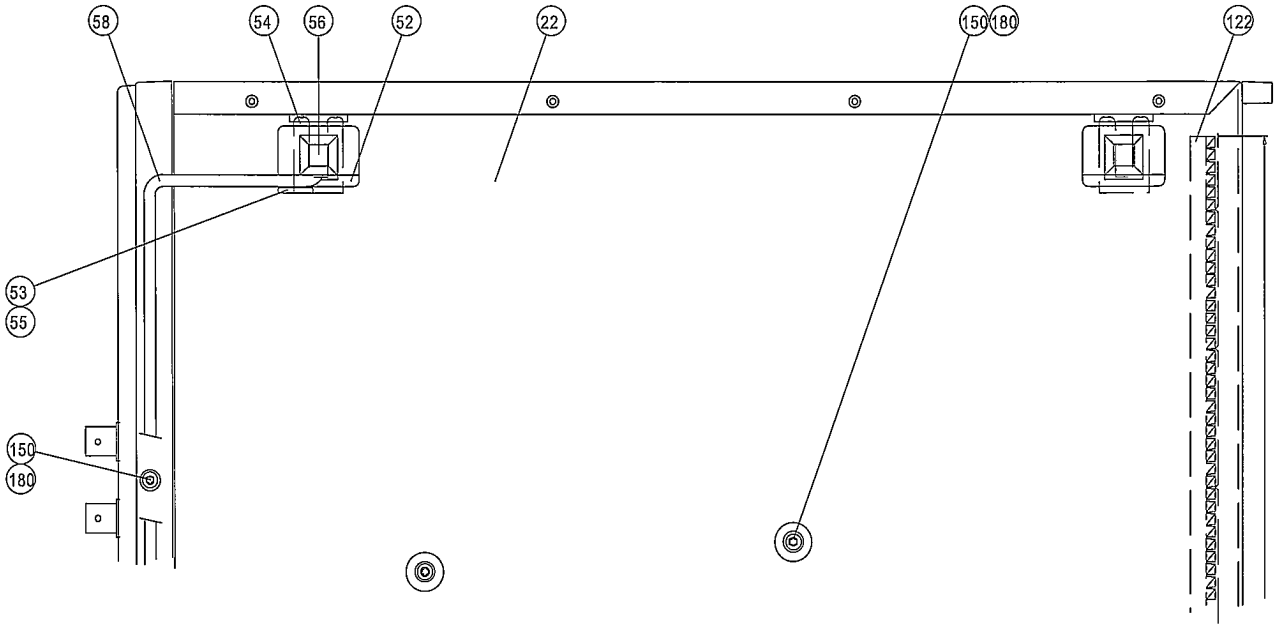
Componenets marked with a 'P' in the ☆ column are 'Production items' not kept in replacement parts stock. These items can be ordered, but the delivery time is longer than for normal replacement parts.

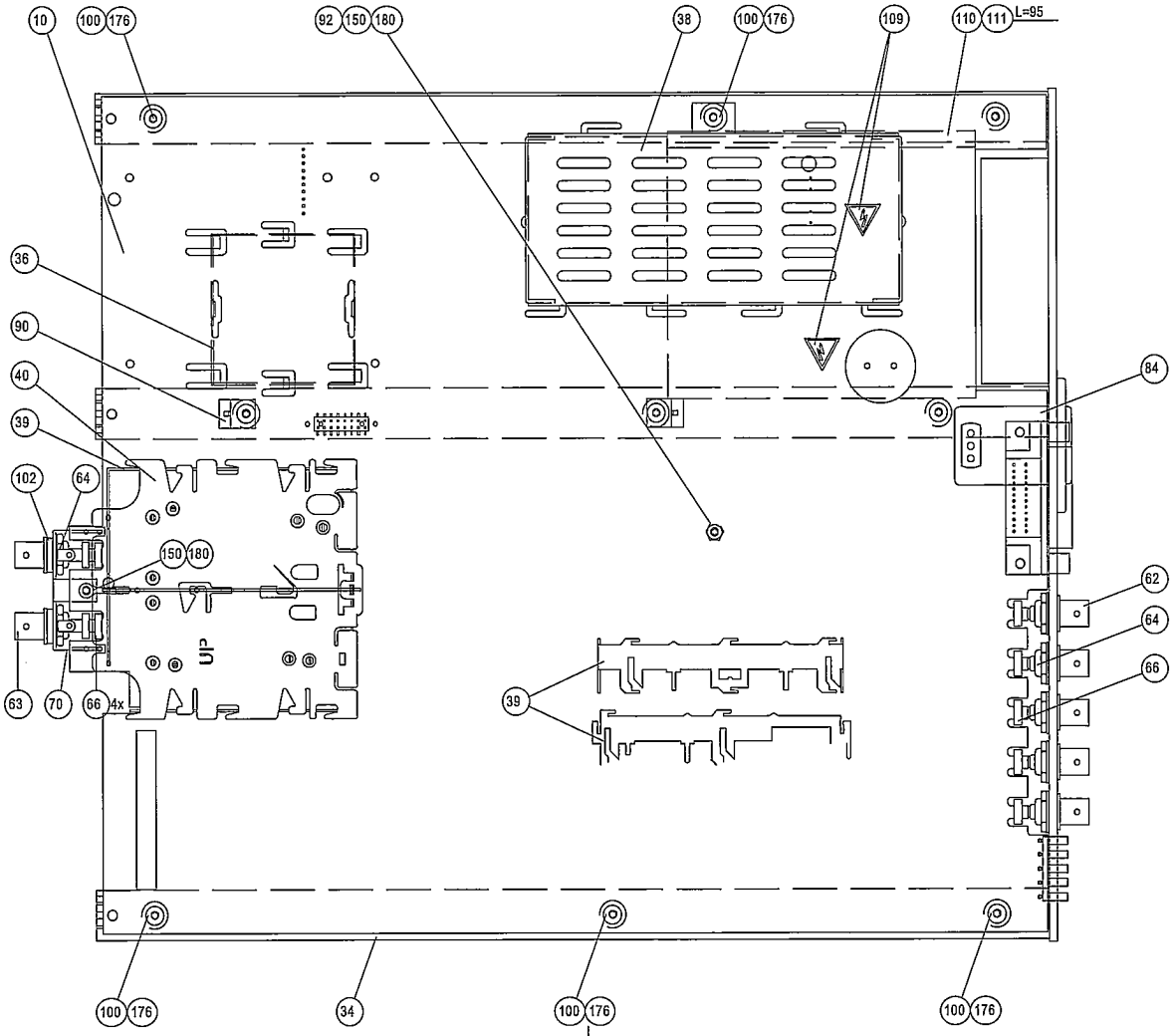


Mechanical Parts

Pos	Description	Part Number	☆
10	PC-B 1 ASSY PM6681 BAS81	5322 214 91332	P
12	PC-B 2 ASSY PM6680 DISP80	5322 218 70109	P
18	Textplate kit PM6681	5322 456 10027	R
20	Rubber keypad PM6680, 81, 85	5322 276 80389	R
22	Cover assy PM6680, 81	5322 447 92194	P
25	Rear plate PM6681	5322 447 92202	P
26	Fan ASF84171 12VDC 80X80X25mm	5322 361 10539	
27	Connector 2 POL 640442-2 AWG26 IDT	5322 265 41371	
34	Profile-support	5322 460 60542	P
36	Shield PM6681	5322 459 11184	P
38	Shield cover PM6681	5322 447 92203	P
39	Shield PM6681	5322 459 11185	P
40	Shield cover PM6681	5322 447 92204	P
50	Rearfoot Cabinet M-90	5322 462 41719	R
52	Bottom foot Cabinet M-90	5322 462 41554	R
53	Bracket Cabinet	5322 401 11422	R
54	Spring Cabinet	5322 492 64745	R
56	Rubber foot SJ-5018 BLACK	5322 462 44434	
58	Bracket stand up PM6680, 81	5322 401 11348	R
62	Connector-COAX KC-79-35	5322 267 10004	
63	COAX Connector	5322 265 10264	R
66	Toroid core 30nH RCC9/6/3 4C65 VIOLET	5322 526 10545	P
84	Mains filter 1A FS3514-1/07	5322 121 42352	
90	PCB guide PM6680, 81, 85 FOR PRESC	5322 401 11347	P

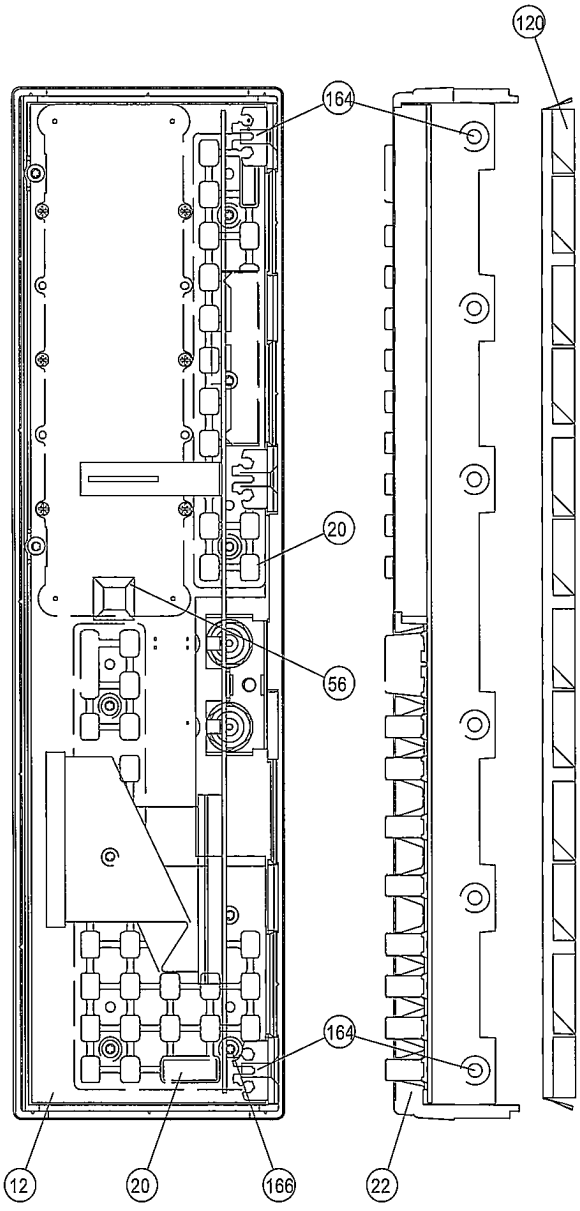
Pos	Description	Part Number	☆
100	Washer 4.0X10X2 PA6-6	5322 532 52364	P
102	Washer 9.5X13X2.3 PM6680, 81, 85	4822 532 10222	P
109	High voltage- WARNING	5322 456 90366	P
110	Insulate plate	5322 466 62465	P
120	Front shield PM6680, 81	5322 462 50466	P
122	Shielding strip 610mm 99-210	5322 466 62077	P
150	Screw MRT 3X06 ST FZB TX	4822 502 11658	P
156	Screw MRT 4X16 ST FZB TX	5322 502 21491	P
160	Screw MFT-TT 3X08 STFZB TX	4822 502 11713	P
164	Screw MFT-TT 4X12 STFZB TX	5322 502 13553	P
166	Screw MRT-TT 3X08 STFZB TX	4822 502 11691	P
168	Screw MRT-TT 4X16 STFZB TX	5322 502 13552	P
172	Screw MFT 4X10 ST FZB TX	5322 502 13641	P
173	Screw MFS 4X35 ST FZB	5322 502 21492	P
176	Screw RTK ST3.5X10 FZB TX	5322 502 30703	P
180	Spring washer KBA 3.2 ST FZ DIN137	4822 530 80173	P
182	Spring washer KBA 4.3 ST FZ DIN137	4822 530 80076	P
184	Lock washer YT4.3 ST FZ DIN6798A	4822 530 80083	P
190	Nut M6M 04 ST FZB	4822 505 10326	P
200	Receptacle 140825-2 2.8X0.8	5322 268 10275	P
201	Protect sleeve 2.8mm N 94610	5322 321 40117	P
202	Cable clip reel SRB-2.5T-M4	5322 358 50107	P
208	FXF tube 3B 4.3x2 L=7.2	4822 526 10097	

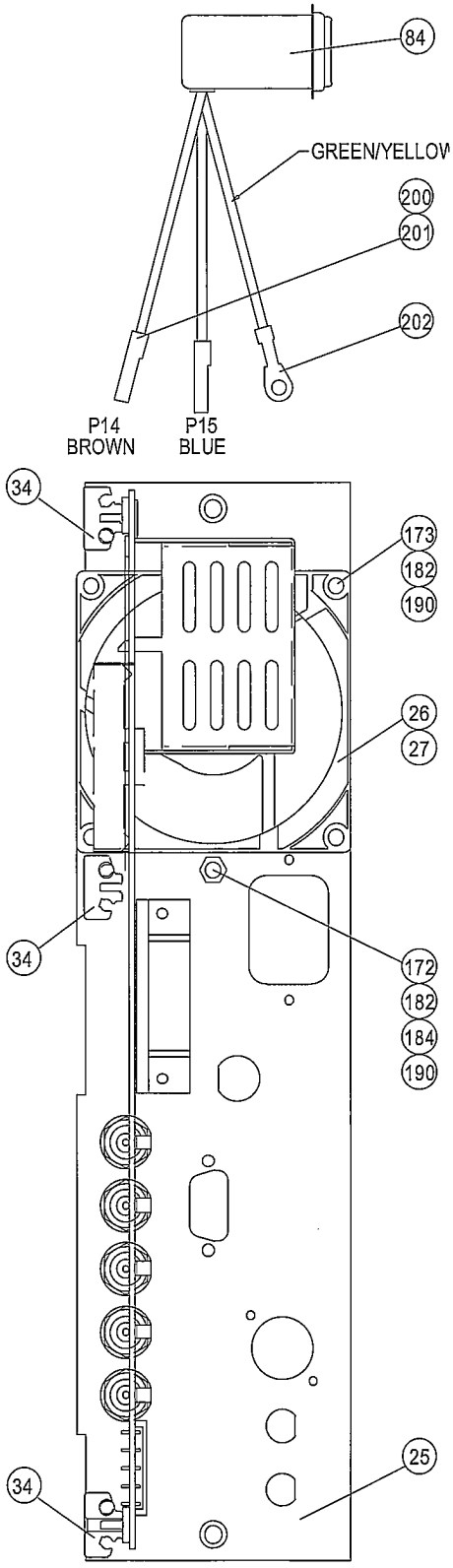



10
100 176
92 150 180
38
100 176
109
110 111 L=95
36
90
40
39
102
64
150 180
63
70
66 4x
39
84
62
64
66
100 176
34
100 176
100 176
UP

Main Board

Pos	Description	Part Number	☆
	PC-B 1 ASSY	5322 214 91332	P
	Screw MRT 3X08 ST FZB TX	5322 502 21489	P
	Lock washer YT3.2 ST FZ DIN6798A	4822 530 80082	P
B1	Crystal 16 MHz PM5781 HC-49/U	5322 242 73307	
B2	Crystal 10 MHz PM9677 HC-49U	5322 242 74372	R
B3	Crystalfilter 100 MHz MF UB	5322 242 81692	
B4	Crystalfilter 100 MHz MF UB	5322 242 81692	
B5	Crystal 10 MHz HC-49U	5322 242 81694	R
C1	Capacitor 2 pF 0.5-2 pF 300V	5322 124 80335	
C2	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C3	Capacitor 1 nF 5% 63V NP0 1206	4822 122 31746	
C4	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C5	Capacitor 22 nF 20% 200V 2F4 1206	5322 126 10527	





Pos	Description	Part Number	☆
C7	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C8	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C9	Capacitor 2 pF 0.5-2 pF 300V	5322 124 80335	
C10	Capacitor 1 nF 5% 63V NP0 1206	4822 122 31746	
C11	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C12	Capacitor 1 nF 5% 63V NP0 1206	4822 122 31746	
C13	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C14	Capacitor 22 nF 20% 200V 2F4 1206	5322 126 10527	
C16	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C17	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C18	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C20	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C21	Capacitor 1 nF 5% 63V NP0 1206	4822 122 31746	
C22	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C24	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C25	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C26	Capacitor 1 nF 5% 63V NP0 1206	4822 122 31746	
C29	Capacitor 10 nF 10% 63V X7R 1206	4822 122 32442	
C30	Capacitor 10 nF 10% 63V X7R 1206	4822 122 32442	
C31	Capacitor 10 nF 10% 63V X7R 1206	4822 122 32442	
C32	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C33	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C34	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C35	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C36	Capacitor 2200 F 20% 16V RAD 2M 12.5X25	4822 124 40723	
C37	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C38	Capacitor 18 pF 2.0-18PF 300V	5322 125 50051	
C39	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C40	Capacitor 18 pF 2.0-18PF 300V	5322 125 50051	
C41	Capacitor 10 nF 10% 63V X7R 1206	4822 122 32442	
C42	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C44	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C46	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C49	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C50	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C51	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C52	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C55	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C57	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C58	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C59	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C60	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C61	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C62	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C63	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C64	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C65	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C66	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C68	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C69	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C71	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C75	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C76	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C77	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C78	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C79	Capacitor 1 nF 5% 63V NP0 1206	4822 122 31746	
C80	Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	
C82	Capacitor 68 F 20% 6.3V SOLID AL	5322 124 10455	
C87	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	

Pos	Description	Part Number	☆
C88	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C89	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C90	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C91	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C92	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C93	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C94	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C95	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C96	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C97	Capacitor 27 pF 5% 63V NP0 1206	4822 122 31825	
C98	Capacitor 27 pF 5% 63V NP0 1206	4822 122 31825	
C99	Capacitor 6.8 pF 0.5 pF 63V NP0 1206	4822 122 32507	
C100	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C101	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C102	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C103	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C104	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C106	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C107	Capacitor 82 pF 5% 63V NP0 1206	4822 122 31839	
C108	Capacitor 82 pF 5% 63V NP0 1206	4822 122 31839	
C109	Capacitor 22 pF 5% 200V NP0 1206	5322 126 13128	
C110	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C111	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C112	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C113	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C114	Capacitor 10 pF 1, 8-10PF 300V	5322 125 50049	
C115	Capacitor 15 pF 2% 100V NP0 2M	4822 122 31823	
C116	Capacitor 15 pF 2% 100V NP0 2M	4822 122 31823	
C117	Capacitor 1 nF 5% 63V NP0 1206	4822 122 31746	
C118	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C119	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C120	Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	
C121	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C122	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C125	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C126	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C127	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C128	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C129	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C130	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C131	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C132	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C133	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C134	Capacitor 10 pF 5% 63V NP0 1206	4822 122 31971	
C135	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C137	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C139	Capacitor 220 pF 20% 200V	5322 126 13129	
C140	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C143	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C144	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C145	Capacitor 12 pF 2% 100V NP0 2M	4822 122 31056	
C146	Capacitor 15 pF 5% 63V NP0 1206	4822 122 32504	
C147	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C148	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C149	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C150	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C151	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C152	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C153	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	

Pos	Description	Part Number	☆
C154	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C156	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C157	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C160	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C165	Capacitor 33 pF 5% 63V NP0 1206	4822 126 10324	
C166	Capacitor 33 pF 5% 63V NP0 1206	4822 126 10324	
C167	Capacitor 1 µF 10% 50V MMKO-5 PETP	5322 121 42515	
C168	Capacitor 1 µF 10% 50V MMKO-5 PETP	5322 121 42515	
C169	Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	
C170	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C171	Capacitor 33 pF 5% 63V NP0 1206	4822 126 10324	
C172	Capacitor 33 pF 5% 63V NP0 1206	4822 126 10324	
C173	Capacitor 2.20 nF PME289MA4220MR04	5322 121 43756	
C174	Capacitor 2.20 nF PME289MA4220MR04	5322 121 43756	
C175	Resistor 0 Ω RC-01 1206	4822 051 10008	
C176	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C177	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C178	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C180	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C181	Capacitor 100 nF 20% 250V	5322 121 44302	
C182	Capacitor 1 µF 10% 50V MMKO-5 PETP	5322 121 42515	
C183	Capacitor 2.20 nF PME289MA4220MR04	5322 121 43756	
C184	Capacitor 2.20 nF PME289MA4220MR04	5322 121 43756	
C186	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C187	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C188	Capacitor 10 nF 10% 63V X7R 1206	4822 122 32442	
C189	Capacitor 33 nF 10% 50V X7R 1206	4822 122 31981	
C190	Capacitor 33 pF 5% 63V NP0 1206	4822 126 10324	
C191	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C192	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C193	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C194	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C196	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C197	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C201	Capacitor 47 pF 5% 63V NP0 1206	4822 122 31772	
C202	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C302	Capacitor 2200 F 20% 16V RAD 2M 12.5X25	4822 124 40723	
C303	Capacitor 68 F 20% 6.3V SOLID AL	5322 124 10455	
C304	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C305	Capacitor 68 F 20% 6.3V SOLID AL	5322 124 10455	
C306	Capacitor 2200 F 20% 16V RAD 2M 12.5X25	4822 124 40723	
C307	Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	
C308	Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	
C310	Capacitor 2.20 µF 20%6.3V 3.2X1.6 MOLD	5322 124 10685	
C311	Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	
C313	Capacitor 6.80 µF 20% 16V 6.0X3.2 MOLD	5322 124 10687	
C314	Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	
C315	Capacitor 6.80 µF 20% 16V 6.0X3.2 MOLD	5322 124 10687	
C316	Capacitor 6.80 µF 20% 16V 6.0X3.2 MOLD	5322 124 10687	
C317	Capacitor 33 F 20% 10V SOLID AL	5322 124 11084	
C318	Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	
C319	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C320	Capacitor 68 F 20% 6.3V SOLID AL	5322 124 10455	
C321	Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	
C323	Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	
C324	Capacitor 68 F 20% 6.3V SOLID AL	5322 124 10455	
C325	Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	
C326	Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	
C327	Capacitor 68 F 20% 6.3V SOLID AL	5322 124 10455	

Pos	Description	Part Number	☆
C328	Capacitor 68 F 20% 6.3V SOLID AL	5322 124 10455	
C329	Capacitor 68 F 20% 6.3V SOLID AL	5322 124 10455	
C330	Capacitor 270 F SMG 20% 400V 25X45	5322 124 80334	
C334	Capacitor 68 F 20% 6.3V SOLID AL	5322 124 10455	
C335	Capacitor 6.80 µF 20% 16V 6.0X3.2 MOLD	5322 124 10687	
C336	Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	
C338	Capacitor 6.80 µF 20% 16V 6.0X3.2 MOLD	5322 124 10687	
C339	Capacitor 6.80 µF 20% 16V 6.0X3.2 MOLD	5322 124 10687	
C340	Capacitor 470 F 20% 35V 2M 12.5x20	5322 126 13131	
C341	Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	
C342	Capacitor 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	
C344	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C345	Capacitor 22 pF 5% 200V NP0 1206	5322 126 13128	
C346	Capacitor 10 pF 1, 8-10PF 300V	5322 125 50049	
C347	Capacitor 10 pF 1, 8-10PF 300V	5322 125 50049	
C348	Capacitor 10 pF 1, 8-10PF 300V	5322 125 50049	
C349	Capacitor 100 pF 5% 63V NP0 1206	4822 122 31765	
C350	Capacitor 10 nF 10% 63V X7R 1206	4822 122 32442	
C351	Capacitor 10 pF 1, 8-10PF 300V	5322 125 50049	
C352	Capacitor 100 pF 5% 63V NP0 1206	4822 122 31765	
C353	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C354	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C355	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C356	Capacitor 18 pF 2.0-18PF 300V	5322 125 50051	
C357	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C358	Capacitor 33 pF 5% 63V NP0 1206	4822 126 10324	
C359	Capacitor 15 pF 5% 63V NP0 1206	4822 122 32504	
C360	Capacitor 2.2 pF 0.25pF 63V NP0 1206	4822 863 15228	
C361	Capacitor 33 pF 5% 63V NP0 1206	4822 126 10324	
C362	Capacitor 15 pF 5% 63V NP0 1206	4822 122 32504	
C363	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C364	Capacitor 6.8 pF 0.5pF 63V NP0 1206	4822 122 32507	
C367	Capacitor 2.2 pF0.25pF 63V NP0 1206	4822 863 15228	
C368	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C369	Capacitor 1 nF 5% 63V NP0 1206	4822 122 31746	
C370	Capacitor 1 nF 5% 63V NP0 1206	4822 122 31746	
C371	Capacitor 220 pF 20% 200V	5322 126 13129	
C372	Capacitor 33 nF 10% 50V X7R 1206	4822 122 31981	
C373	Capacitor 33 nF 10% 50V X7R 1206	4822 122 31981	
C374	Capacitor 33 nF 10% 50V X7R 1206	4822 122 31981	
C375	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C376	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C377	Capacitor 47 nF 10% 250V POLYCARB	4822 121 41676	
C378	Capacitor 330 nF 20% 250V	5322 121 44222	
C379	Capacitor 220 pF 20% 200V	5322 126 13129	
C381	Capacitor 100 µF 20% 35V 2M 8.2x11	5322 124 40852	
C382	Capacitor 220 pF 20% 200V	5322 126 13129	
C383	Capacitor 100 pF 5% 63V NP0 1206	4822 122 31765	
C384	Capacitor 22 pF 5% 200V NP0 1206	5322 126 13128	
C385	Capacitor 4.7 nF 10% 63V X7R 1206	4822 122 31784	
C386	Capacitor 4.7 nF 10% 63V X7R 1206	4822 122 31784	
C387	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C388	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C389	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C390	Capacitor 470 F 20% 35V 2M 12.5x20	5322 126 13131	
C391	Capacitor 470 F 20% 35V 2M 12.5x20	5322 126 13131	
C392	Capacitor 10000 µF 20% 6.3V 3M 18x35	5322 124 80821	
C393	Capacitor 1 nF 5% 63V NP0 1206	4822 122 31746	
C394	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	

Pos	Description	Part Number	☆
C395	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C396	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C397	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C398	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C403	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C404	Capacitor 12 pF 5% 63V NP0 1206	4822 122 32139	
C405	Capacitor 12 pF 5% 63V NP0 1206	4822 122 32139	
C406	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C407	Capacitor 100 pF 5% 63V NP0 1206	4822 122 31765	
C408	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C409	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C410	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C411	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C412	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C415	Capacitor 5.6 pF 0.5 pF 63V NP0 1206	4822 122 32506	
C416	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C417	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C418	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C419	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C420	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C421	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C426	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C427	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C428	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C429	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C430	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C432	Capacitor 18 pF 2.0-18PF 300V	5322 125 50051	
C436	Capacitor 18 pF 2.0-18 pF 300V	5322 125 50051	
C441	Capacitor 12 pF 5% 63V NP0 1206	4822 122 32139	
C442	Capacitor 12 pF 5% 63V NP0 1206	4822 122 32139	
C445	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C447	Capacitor 33 pF 5% 63V NP0 1206	4822 126 10324	
C448	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C449	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C450	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C451	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C452	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C453	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	
C454	Capacitor 1 nF 5% 63V NP0 1206	4822 122 31746	
D4	Diode 0.10A BAV99 SOT23	5322 130 34337	
D5	Diode 0.10A BAV99 SOT23	5322 130 34337	
D6	Diode 0.10A BAV99 SOT23	5322 130 34337	
D7	Diode 0.10A BAV99 SOT23	5322 130 34337	
D8	Diode 0.10A BAT18 35V 1 pF SOT23	5322 130 32076	
D9	Diode 0.10A BAT18 35V 1 pF SOT23	5322 130 32076	
D10	Diode 0.10A BAT18 35V 1 pF SOT23	5322 130 32076	
D11	Diode 0.10A BAT18 35V 1 pF SOT23	5322 130 32076	
D12	Diode 0.10A BAV99 SOT23	5322 130 34337	
D13	Diode 0.10A BAV99 SOT23	5322 130 34337	
D18	Diode 0.10A BAV99 SOT23	5322 130 34337	
D23	Diode 0.10A BAV99 SOT23	5322 130 34337	
D24	Diode 0.10A BAR42 30V SOT23	5322 130 83586	
D26	Diode 0.10A BAV99 SOT23	5322 130 34337	
D27	Diode 0.10A BAV99 SOT23	5322 130 34337	
D30	Diode 0.15A BAS45 125V DO-35	5322 130 32256	
D31	Diode 0.10A BAR42 30V SOT23	5322 130 83586	
D32	Diode 0.10A BAV99 SOT23	5322 130 34337	
D33	Diode 0.10A BAV99 SOT23	5322 130 34337	
D35	Diode 0.10A BAV99 SOT23	5322 130 34337	

Pos	Description	Part Number	☆
D38	Diode 0.10A BAV99 SOT23	5322 130 34337	
D40	Bridge rectif 4A KBU4K 800V	4822 130 80497	
D41	Diode 0.25A BAW56 70V SOT23	5322 130 30691	
D42	Diode 7A BYW29/200 TO-220AC	5322 130 32328	
D43	Heat sink 16$K/W TO220	5322 255 41313	P
D43	Diode 7.5A MBR760 60V TO220	5322 130 83602	
D44	Diode 0.10A BAV99 SOT23	5322 130 34337	
D45	Diode 0.10A BAV99 SOT23	5322 130 34337	
D47	Diode 0.35 W BZX84-C8V2 SOT23	5322 130 80255	
D48	Diode BYV26E DOD57	4822 130 60815	
D49	Diode 0.35 W BZX84-C18 SOT23	5322 130 80212	
D50	Diode 0.2A BAV23 200V SOT143	5322 130 33764	
D52	Diode 0.35 W BZX84-C18 SOT23	5322 130 80212	
D53	Diode 0.35 W BZX84-C18 SOT23	5322 130 80212	
D54	Diode 0.35 W BZX84-C8V2 SOT23	5322 130 80255	
D55	Diode 0.2A BAV23 200V SOT143	5322 130 33764	
D56	Diode 0.2A BAV23 200V SOT143	5322 130 33764	
D57	Heat sink 16$K/W TO220	5322 255 41313	P
D57	Diode 7A BYW29/200 TO-220AC	5322 130 32328	
D58	Diode 0.10A BAV99 SOT23	5322 130 34337	
D59	Diode 0.10A BAR42 30V SOT23	5322 130 83586	
D60	Diode 0.35W BZX84-B5V6 2% SOT23	4822 130 33004	
D61	Diode 0.10A BAV99 SOT23	5322 130 34337	
D62	Diode 0.10A BAV99 SOT23	5322 130 34337	
D64	Diode 0.10A BAV99 SOT23	5322 130 34337	
D66	Diode 0.2A BAV23 200V SOT143	5322 130 33764	
F1	Fuse 1.6A 5X20 T FST034.3119	4822 253 30024	
F1	Fuse holder 011 656 5X20mm	4822 256 30139	
G1	Battery holder 20mm BH800	5322 256 60311	
G1	Battery 3V BR2032 190mAH 20x3.2	4822 138 10082	P
GND5	Connector 3 POL F095 single row	5322 290 60445	
GND6	Connector 3 POL F095 single row	5322 290 60445	
GND7	Connector 3 POL F095 SINGLE ROW	5322 290 60445	
J12	Connector 3 POL F095 single row	5322 290 60445	
J12	Connector 2POL F095 jumper grey	5322 263 50101	
J15	Connector 2POL F095 jumper grey	5322 263 50101	
J15	Connector 3 POL F095 single row	5322 290 60445	
J17	Cable assy PM6681	5322 321 62336	P
J18	Connector 2 POL F095 single row	5322 265 44074	
J19	Connector 24 POL 57LE-20240-77OOD35G	5322 267 60148	
K1	Relay 2p vx V23042-A1003-B101	5322 280 60557	R
K2	Relay TQ2-5 SV/1A 2pol vx 14X9X5m	5322 280 20514	R
K3	Relay TQ2-5 SV/1A 2pol vx 14X9X5m	5322 280 20514	R
K4	Relay TQ2-5 SV/1A 2pol vx 14X9X5m	5322 280 20514	R
K5	Relay TQ2-5 SV/1A 2pol vx 14X9X5m	5322 280 20514	R
K6	Relay TQ2-5 SV/1A 2pol vx 14X9X5m	5322 280 20514	R
K7	Relay TQ2-5 SV/1A 2pol vx 14X9X5m	5322 280 20514	R
K8	Relay TQ2-5 SV/1A 2pol vx 14X9X5m	5322 280 20514	R
K9	Relay TQ2-5 SV/1A 2pol vx 14X9X5m	5322 280 20514	R
L1	Choke 220 µH 10% NL453232T-221K	5322 157 61918	
L3	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L4	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L5	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L7	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L8	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L9	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L10	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L11	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L12	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	

Pos	Description	Part Number	☆
L13	Choke 1 µH 10% MLF3216D1R0K	5322 157 62555	
L14	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L15	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L16	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L17	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L18	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L19	Choke 33 µH TSL0807-330K1R2	5322 157 53568	
L20	Choke 10 mH B82722-J2102-N1 1A	5322 157 70143	
L21	Choke 10 µH TSL1110-100M3R2	5322 157 52513	
L22	Choke 10 µH TSL1110-100M3R2	5322 157 52513	
L23	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L24	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L25	Choke 0.15 µH 10% MLF3216DR15K	5322 157 71041	
L26	Choke 0.15 µH 10% MLF3216DR15K	5322 157 71041	
L27	Choke 0.15 µH 10% MLF3216DR15K	5322 157 71041	
L28	Choke 0.15 µH 10% MLF3216DR15K	5322 157 71041	
L29	Choke 0.15 µH 10% MLF3216DR15K	5322 157 71041	
L30	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L31	Choke 4.70 µH 10% MLF3216A4R7KT	4822 157 70975	
L32	Choke 4.70 µH 10% MLF3216A4R7KT	4822 157 70975	
L33	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L39	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L40	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L41	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L42	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L43	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L45	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L46	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L47	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L48	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L49	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L50	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L51	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L52	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L53	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L54	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L55	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L56	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L57	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L58	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L59	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L60	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
L61	Choke 4S2 3.5X6MM 80 Ω at 100 MHz	5322 157 61928	
P7	Connector 3 POL F095 SINGLE ROW	5322 290 60445	
P18	Flat pin 2.8mm E184/8 LESA SN BAND	5322 290 34064	
P19	Flat pin 2.8mm E184/8 LESA SN BAND	5322 290 34064	
P20	Connector 16 POL F095 DOUBLE ROW	5322 265 40262	
P21	Connector 10 POL 22-03-2101 4030-10A	5322 265 64028	
P25	Connector 5 POL 334 2142 2 05 53 0	5322 265 41369	
P109	Soldering tag 9.6X15/15 MS FS	5322 290 30318	
R4	Resistor 47.0 kΩ 0.5% 1/8 W RC-03G 1206	5322 117 10857	
R5	Resistor 330 kΩ 1% 1/8 W 100PPM 1206	5322 117 10969	
R6	Resistor 470.0 kΩ 0.5% 1/8 W RC-03G 1206	5322 117 10858	
R7	Resistor 56.0 kΩ 1% 1/8 W 100PPM 1206	5322 117 10971	
R8	Resistor 470.0 kΩ 0.5% 1/8 W RC-03G 1206	5322 117 10858	
R10	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R11	Resistor 2.70 kΩ 1% 1/8 W 100PPM 1206	4822 051 52702	

Pos	Description	Part Number	☆
R12	Resistor 1.80 kΩ 1% 1/8 W 100PPM 1206	4822 051 10182	
R13	Resistor 220.0 Ω 1% 1/8 W 100PPM 1206	4822 051 52201	
R14	Resistor 1.50 kΩ 1% 1/8 W 100PPM 1206	4822 051 51502	
R15	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R16	Resistor 470.0 KΩ 0.5% 1/8 W RC-03G	5322 117 10858	
R17	Resistor 470.0 kΩ 0.5% 1/8 W RC-03G	5322 117 10858	
R18	Potentiometer 20 kΩ 10% 3323P-1-203-10	5322 101 11074	
R19	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R20	Resistor 390 Ω 1% 1/8 W 100PPM 1206	4822 051 53901	
R21	Resistor 390 Ω 1% 1/8 W 100PPM 1206	4822 051 53901	
R22	Resistor 470.0 kΩ 0.5% 1/8 W RC-03G	5322 117 10858	
R23	Resistor 470.0 kΩ 0.5% 1/8 W RC-03G 1206	5322 117 10858	
R24	Resistor 15.0 kΩ 1% 1/8 W 100PPM 1206	5322 116 82261	
R25	Resistor 330 Ω 1% 1/8 W 100PPM 1206	4822 051 53301	
R26	Resistor 330 Ω 1% 1/8 W 100PPM 1206	4822 051 53301	
R27	Resistor 470.0 kΩ 0.5% 1/8 W RC-03G 1206	5322 117 10858	
R28	Resistor 56.0 kΩ 1% 1/8 W 100PPM 1206	5322 117 10971	
R29	Resistor 470.0 kΩ 0.5% 1/8 W RC-03G 1206	5322 117 10858	
R30	Resistor 47.0 kΩ 0.5% 1/8 W RC-03G 1206	5322 117 10857	
R31	Resistor 330 kΩ 1% 1/8 W 100PPM 1206	5322 117 10969	
R32	Resistor 470.0 kΩ 0.5% 1/8 W RC-03G 1206	5322 117 10858	
R34	Resistor 56.0 kΩ 1% 1/8 W 100PPM 1206	5322 117 10971	
R35	Resistor 470.0 kΩ 0.5% 1/8 W RC-03G 1206	5322 117 10858	
R36	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R37	Resistor 2.70 kΩ 1% 1/8 W 100PPM 1206	4822 051 52702	
R38	Resistor 1.80 kΩ 1% 1/8 W 100PPM 1206	4822 051 10182	
R39	Resistor 220.0 Ω 1% 1/8 W 100PPM 1206	4822 051 52201	
R40	Resistor 1.50 kΩ 1% 1/8 W 100PPM 1206	4822 051 51502	
R41	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R42	Resistor 470.0 kΩ 0.5% 1/8 W RC-03G 1206	5322 117 10858	
R43	Resistor 470.0 kΩ 0.5% 1/8 W RC-03G 1206	5322 117 10858	
R44	Potentiometer 20 kΩ 10% 3323P-1-203-10	5322 101 11074	
R45	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R46	Resistor 390 Ω 1% 1/8 W 100PPM 1206	4822 051 53901	
R47	Resistor 390 Ω 1% 1/8 W 100PPM 1206	4822 051 53901	
R48	Resistor 470.0 kΩ 0.5% 1/8 W RC-03G 1206	5322 117 10858	
R49	Resistor 470.0 kΩ 0.5% 1/8 W RC-03G 1206	5322 117 10858	
R50	Resistor 15.0 kΩ 1% 1/8 W 100PPM 1206	5322 116 82261	
R51	Resistor 330 Ω 1% 1/8 W 100PPM 1206	4822 051 53301	
R52	Resistor 470.0 kΩ 0.5% 1/8 W RC-03G 1206	5322 117 10858	
R53	Resistor 56.0 kΩ 1% 1/8 W 100PPM 1206	5322 117 10971	
R54	Resistor 470.0 kΩ 0.5% 1/8 W RC-03G 1206	5322 117 10858	
R55	Resistor 150 Ω 1% 1/8 W 100PPM 1206	4822 051 51501	
R56	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R57	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R58	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R59	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R60	Resistor 470 Ω 1% 1/8 W 100PPM 1206	4822 051 54701	
R61	Resistor 390 Ω 1% 1/8 W 100PPM 1206	4822 051 53901	
R62	Resistor 390 Ω 1% 1/8 W 100PPM 1206	4822 051 53901	
R63	Resistor 220.0 Ω 1% 1/8 W 100PPM 1206	4822 051 52201	
R64	Resistor 68 Ω 1% 1/8 W 100PPM 1206	4822 051 10689	
R65	Resistor 68 Ω 1% 1/8 W 100PPM 1206	4822 051 10689	
R66	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R67	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R68	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R69	Resistor 82 Ω 1% 1/8 W 100PPM 1206	4822 051 10829	

Pos	Description	Part Number	☆
R70	Resistor 150 Ω 1% 1/8 W 100PPM 1206	4822 051 51501	
R71	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R72	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R73	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R74	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R75	Resistor 470 Ω 1% 1/8 W 100PPM 1206	4822 051 54701	
R76	Resistor 390 Ω 1% 1/8 W 100PPM 1206	4822 051 53901	
R77	Resistor 390 Ω 1% 1/8 W 100PPM 1206	4822 051 53901	
R78	Resistor 220.0 Ω 1% 1/8 W 100PPM 1206	4822 051 52201	
R79	Resistor 68 Ω 1% 1/8 W 100PPM 1206	4822 051 10689	
R80	Resistor 68 Ω 1% 1/8 W 100PPM 1206	4822 051 10689	
R81	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R82	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R83	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R84	Resistor 82 Ω 1% 1/8 W 100PPM 1206	4822 051 10829	
R85	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R86	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R87	Resistor 82 Ω 1% 1/8 W 100PPM 1206	4822 051 10829	
R88	Resistor 82 Ω 1% 1/8 W 100PPM 1206	4822 051 10829	
R90	Resistor 82 Ω 1% 1/8 W 100PPM 1206	4822 051 10829	
R91	Resistor 15.0 Ω 1% 1/8 W 100PPM 1206	4822 051 10159	
R92	Resistor 82 Ω 1% 1/8 W 100PPM 1206	4822 051 10829	
R94	Resistor 15.0 Ω 1% 1/8 W 100PPM 1206	4822 051 10159	
R95	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R96	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R97	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R98	Resistor 1.0 Ω 1% 1/8 W 100PPM 1206	5322 117 10967	
R99	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R100	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R101	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R102	Resistor 82 Ω 1% 1/8 W 100PPM 1206	4822 051 10829	
R103	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R104	Resistor 120 Ω 1% 1/8 W 100PPM 1206	4822 051 10121	
R105	Resistor 120 Ω 1% 1/8 W 100PPM 1206	4822 051 10121	
R108	Resistor 10 MΩ 10% 1/4 W RC-01 1206	4822 051 10106	
R109	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R110	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R111	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R112	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R113	Resistor 10 MΩ 10% 1/4 W RC-01 1206	4822 051 10106	
R116	Resistor 10.0 Ω 1% 1/8 W 100PPM 1206	4822 051 10109	
R118	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R124	Resistor 10.0 Ω 1% 1/8 W 100PPM 1206	4822 051 10109	
R125	Resistor 12.0 kΩ 1% 1/8 W 100PPM 1206	5322 117 10968	
R126	Resistor 8.20 kΩ 1% 1/8 W 100PPM 1206	4822 051 10822	
R127	Resistor 220.0 Ω 1% 1/8 W 100PPM 1206	4822 051 52201	
R128	Resistor 680 Ω 1% 1/8 W 100PPM 1206	4822 051 56801	
R129	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R131	Resistor 27 Ω 1% 1/8 W 100PPM 1206	5322 116 82262	
R132	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R133	Resistor 27 Ω 1% 1/8 W 100PPM 1206	5322 116 82262	
R134	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R135	Resistor 39 Ω 1% 1/8 W 100PPM 1206	5322 116 82263	
R136	Resistor 39 Ω 1% 1/8 W 100PPM 1206	5322 116 82263	
R137	Resistor 39 Ω 1% 1/8 W 100PPM 1206	5322 116 82263	
R138	Resistor 39 Ω 1% 1/8 W 100PPM 1206	5322 116 82263	
R139	Resistor 39 Ω 1% 1/8 W 100PPM 1206	5322 116 82263	

Pos	Description	Part Number	☆
R140	Resistor 39 Ω 1% 1/8 W 100PPM 1206	5322 116 82263	
R141	Resistor 39 Ω 1% 1/8 W 100PPM 1206	5322 116 82263	
R142	Resistor 39 Ω 1% 1/8 W 100PPM 1206	5322 116 82263	
R143	Resistor 39 Ω 1% 1/8 W 100PPM 1206	5322 116 82263	
R144	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R145	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R146	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R147	Resistor 39 Ω 1% 1/8 W 100PPM 1206	5322 116 82263	
R148	Resistor 39 Ω 1% 1/8 W 100PPM 1206	5322 116 82263	
R149	Resistor 39 Ω 1% 1/8 W 100PPM 1206	5322 116 82263	
R150	Resistor 39 Ω 1% 1/8 W 100PPM 1206	5322 116 82263	
R151	Resistor 39 Ω 1% 1/8 W 100PPM 1206	5322 116 82263	
R152	Resistor 39 Ω 1% 1/8 W 100PPM 1206	5322 116 82263	
R153	Resistor 39 Ω 1% 1/8 W 100PPM 1206	5322 116 82263	
R154	Resistor 39 Ω 1% 1/8 W 100PPM 1206	5322 116 82263	
R155	Resistor 39 Ω 1% 1/8 W 100PPM 1206	5322 116 82263	
R156	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R157	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R158	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R161	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R162	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R163	Resistor 82 Ω 1% 1/8 W 100PPM 1206	4822 051 10829	
R164	Resistor 82 Ω 1% 1/8 W 100PPM 1206	4822 051 10829	
R165	Resistor 330 Ω 1% 1/8 W 100PPM 1206	4822 051 53301	
R166	Resistor 10.0 Ω 1% 1/8 W 100PPM 1206	4822 051 10109	
R169	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R170	Resistor 330 Ω 1% 1/8 W 100PPM 1206	4822 051 53301	
R171	Resistor 560 Ω 1% 1/8 W 100PPM 1206	4822 051 10561	
R172	Resistor 2.20 kΩ 1% 1/8 W 100PPM 1206	4822 051 52202	
R173	Resistor 2.20 kΩ 1% 1/8 W 100PPM 1206	4822 051 52202	
R174	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R175	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R176	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R177	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R178	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R179	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R180	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R181	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R182	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R183	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R184	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R185	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R186	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R187	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R188	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R189	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R190	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R191	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R192	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R193	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R194	Resistor 39.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 53903	
R195	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R196	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R197	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R198	Resistor 220.0 Ω 1% 1/8 W 100PPM 1206	4822 051 52201	
R199	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R200	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	

Pos	Description	Part Number	☆
R201	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R202	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R203	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R204	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R206	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R207	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R208	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R209	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R210	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R211	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R212	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R216	Resistor 0 Ω RC-01 1206	4822 051 10008	
R217	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R220	Resistor 820 Ω 1% 1/8 W 100PPM 1206	5322 116 82264	
R221	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R222	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R223	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R224	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R225	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R226	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R227	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R228	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R229	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R230	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R231	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R232	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R233	Resistor 270 Ω 1% 1/8 W 100PPM 1206	4822 051 10271	
R234	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R235	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R236	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R237	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R238	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R239	Resistor 1.00 MΩ 1% 1/8 W 100PPM 1206	4822 051 10105	
R240	Resistor 560 Ω 1% 1/8 W 100PPM 1206	4822 051 10561	
R241	Resistor 2.70 kΩ 1% 1/8 W 100PPM 1206	4822 051 52702	
R242	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R243	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R244	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R245	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R246	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R247	Resistor 68 Ω 1% 1/8 W 100PPM 1206	4822 051 10689	
R248	Resistor 68 Ω 1% 1/8 W 100PPM 1206	4822 051 10689	
R249	Resistor 15.0 kΩ 1% 1/8 W 100PPM 1206	5322 116 82261	
R250	Resistor 15.0 kΩ 1% 1/8 W 100PPM 1206	5322 116 82261	
R251	Resistor 560 Ω 1% 1/8 W 100PPM 1206	4822 051 10561	
R252	Resistor 4.70 kΩ 1% 1/8 W 100PPM 1206	4822 051 54702	
R253	Resistor 120 Ω 1% 1/8 W 100PPM 1206	4822 051 10121	
R254	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R255	Resistor 4.70 kΩ 1% 1/8 W 100PPM 1206	4822 051 54702	
R256	Resistor 270 Ω 1% 1/8 W 100PPM 1206	4822 051 10271	
R257	Resistor 150 Ω 1% 1/8 W 100PPM 1206	4822 051 51501	
R258	Resistor 1.50 kΩ 1% 1/8 W 100PPM 1206	4822 051 51502	
R259	Resistor 470 Ω 1% 1/8 W 100PPM 1206	4822 051 54701	
R260	Resistor 470 Ω 1% 1/8 W 100PPM 1206	4822 051 54701	
R261	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R263	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R264	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R265	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R266	Resistor 27 Ω 1% 1/8 W 100PPM 1206	5322 116 82262	
R269	Resistor 3.30 kΩ 1% 1/8 W 100PPM 1206	4822 051 53302	
R270	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R271	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R273	Resistor 22 Ω 1% 1/8 W 100PPM 1206	4822 051 10229	
R274	Resistor 22 Ω 1% 1/8 W 100PPM 1206	4822 051 10229	
R276	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R277	Resistor 180.0 Ω 1% 1/8 W 100PPM 1206	4822 051 10181	
R278	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R279	Resistor 680 Ω 1% 1/8 W 100PPM 1206	4822 051 56801	
R280	Resistor 27 Ω 1% 1/8 W 100PPM 1206	5322 116 82262	
R282	Resistor 220.0 Ω 1% 1/8 W 100PPM 1206	4822 051 52201	
R283	Resistor 470 Ω 1% 1/8 W 100PPM 1206	4822 051 54701	
R284	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R285	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R286	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R287	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R288	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R289	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R290	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R293	Resistor 120 Ω 1% 1/8 W 100PPM 1206	4822 051 10121	
R294	Resistor 120 Ω 1% 1/8 W 100PPM 1206	4822 051 10121	
R295	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R296	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R297	Resistor 220.0 Ω 1% 1/8 W 100PPM 1206	4822 051 52201	
R298	Resistor 220.0 Ω 1% 1/8 W 100PPM 1206	4822 051 52201	
R299	Resistor 6.80 kΩ 1% 1/8 W 100PPM 1206	4822 051 10682	
R300	Resistor 6.80 kΩ 1% 1/8 W 100PPM 1206	4822 051 10682	
R301	Resistor 820 Ω 1% 1/8 W 100PPM 1206	5322 116 82264	
R302	Resistor 820 Ω 1% 1/8 W 100PPM 1206	5322 116 82264	
R303	Resistor 150 Ω 1% 1/8 W 100PPM 1206	4822 051 51501	
R304	Resistor 150 Ω 1% 1/8 W 100PPM 1206	4822 051 51501	
R305	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R306	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R307	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R308	Potentiometer 20 kΩ 10% 3323P-1-203-10	5322 101 11074	
R309	Resistor 68.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 56803	
R310	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R311	Potentiometer 20 kΩ 10% 3323P-1-203-10	5322 101 11074	
R312	Resistor 68.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 56803	
R313	Resistor 3.30 kΩ 1% 1/8 W 100PPM 1206	4822 051 53302	
R314	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R316	Resistor 3.30 kΩ 1% 1/8 W 100PPM 1206	4822 051 53302	
R317	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R319	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R320	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R321	Resistor 10 kΩ 0.1% 1/4 W MPR24	5322 116 82868	
R322	Resistor 10 kΩ 0.1% 1/4 W MPR24	5322 116 82868	
R323	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R324	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R325	Resistor 680 Ω 1% 1/8 W 100PPM 1206	4822 051 56801	
R326	Resistor 680 Ω 1% 1/8 W 100PPM 1206	4822 051 56801	
R327	Resistor 680 Ω 1% 1/8 W 100PPM 1206	4822 051 56801	
R328	Resistor 0 Ω RC-01 1206	4822 051 10008	
R329	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R330	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	

Pos	Description	Part Number	☆
R331	Potentiometer 20 kΩ 10% 3323P-1-203-10	5322 101 11074	
R332	Resistor 22.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 52203	
R334	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R335	Resistor 180.0 Ω 1% 1/8 W 100PPM 1206	4822 051 10181	
R336	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R337	Thermistor 16 Ω 20% 3.5A S236/16	5322 116 30457	
R339	Resistor 180.0 Ω 1% 1/8 W 100PPM 1206	4822 051 10181	
R340	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R341	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R342	Resistor 470 Ω 1% 1/8 W 100PPM 1206	4822 051 54701	
R344	Resistor 3.30 kΩ 1% 1/8 W 100PPM 1206	4822 051 53302	
R345	Resistor 15.0 kΩ 1% 1/8 W 100PPM 1206	5322 116 82261	
R346	Resistor 470.0 kΩ 0.5% 1/8 W RC-03G 1206	5322 117 10858	
R347	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R348	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R349	Resistor 33 Ω 5% 1.6W PR37	4822 116 51167	
R350	Resistor 15.0 kΩ 1% 1/8 W 100PPM 1206	5322 116 82261	
R352	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R353	Resistor 0.22 Ω 5% SN14L2EJ	5322 116 53071	
R354	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R355	Resistor 1.00 MΩ 1% 1/8 W 100PPM 1206	4822 051 10105	
R356	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R357	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R358	Resistor 33 kΩ 1% 1/8 W 100PPM 1206	4822 051 53303	
R359	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R360	Resistor 1.80 kΩ 1% 1/8 W 100PPM 1206	4822 051 10182	
R361	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R365	Resistor 560 Ω 1% 1/8 W 100PPM 1206	4822 051 10561	
R366	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R367	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R368	Resistor 82 Ω 1% 1/8 W 100PPM 1206	4822 051 10829	
R369	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R370	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R371	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R372	Resistor 390 Ω 1% 1/8 W 100PPM 1206	4822 051 53901	
R373	Resistor 560 Ω 1% 1/8 W 100PPM 1206	4822 051 10561	
R374	Resistor 2.20 kΩ 1% 1/8 W 100PPM 1206	4822 051 52202	
R375	Resistor 560 Ω 1% 1/8 W 100PPM 1206	4822 051 10561	
R377	Resistor 4.70 kΩ 1% 1/8 W 100PPM 1206	4822 051 54702	
R378	Resistor 4.70 kΩ 1% 1/8 W 100PPM 1206	4822 051 54702	
R379	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R380	Resistor 4.70 kΩ 1% 1/8 W 100PPM 1206	4822 051 54702	
R381	Potentiometer 1kΩ 20% 3323P-1-102	4822 101 10792	
R382	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R383	Resistor 330 Ω 1% 1/8 W 100PPM 1206	4822 051 53301	
R384	Potentiometer 20 kΩ 10% 3323P-1-203-10	5322 101 11074	
R385	Resistor 3.30 kΩ 1% 1/8 W 100PPM 1206	4822 051 53302	
R386	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R387	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R388	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R402	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R403	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R404	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R405	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R406	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R407	Resistor 330 Ω 1% 1/8 W 100PPM 1206	4822 051 53301	
R408	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	

Pos	Description	Part Number	☆
R409	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R426	Resistor 680 Ω 1% 1/8 W 100PPM 1206	4822 051 56801	
R427	Resistor 680 Ω 1% 1/8 W 100PPM 1206	4822 051 56801	
R428	Resistor 470.0 kΩ 0.5% 1/8 W RC-03G 1206	5322 117 10858	
R429	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R430	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R431	Resistor 27 Ω 1% 1/8 W 100PPM 1206	5322 116 82262	
R432	Resistor 82 Ω 1% 1/8 W 100PPM 1206	4822 051 10829	
R433	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R435	Resistor 82 Ω 1% 1/8 W 100PPM 1206	4822 051 10829	
R436	Resistor 82 Ω 1% 1/8 W 100PPM 1206	4822 051 10829	
R437	Resistor 270 Ω 1% 1/8 W 100PPM 1206	4822 051 10271	
R438	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R439	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R440	Resistor 2.20 kΩ 1% 1/8 W 100PPM 1206	4822 051 52202	
R441	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R442	Resistor 1.80 kΩ 1% 1/8 W 100PPM 1206	4822 051 10182	
R443	Resistor 3.90 kΩ 1% 1/8 W 100PPM 1206	4822 051 53902	
R444	Resistor 47.0 kΩ 0.5% 1/8 W RC-03G 1206	5322 117 10857	
R445	Resistor 220 kΩ 1% 1/8 W 100PPM 1206	4822 051 52204	
R446	Potentiometer 1kΩ 20% 3323P-1-102	4822 101 10792	
R447	Resistor 3.30 kΩ 1% 1/8 W 100PPM 1206	4822 051 53302	
R448	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R449	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R450	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R451	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R452	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R453	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R454	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R455	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R456	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R460	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R461	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R462	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R463	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R464	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R465	Resistor 4.7 Ω 10% 1/4 W RC-01 1206	4833 051 10478	
R466	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R467	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R468	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R469	Resistor 10.0 Ω 1% 1/8 W 100PPM 1206	4822 051 10109	
R470	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R471	Resistor 2.7 Ω 5% 1/4 W RC-01 1206	4822 051 10278	
R472	Resistor 2.7 Ω 5% 1/4 W RC-01 1206	4822 051 10278	
R473	Resistor 2.7 Ω 5% 1/4 W RC-01 1206	4822 051 10278	
R474	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R475	Resistor 10.0 Ω 1% 1/8 W 100PPM 1206	4822 051 10109	
R476	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R477	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R478	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R479	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R480	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R481	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R482	Varistor 95V 95VRMS4.1J	5322 116 21222	
R483	Resistor 4.70 kΩ 1% 1/8 W 100PPM 1206	4822 051 54702	
R484	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R485	Resistor 22.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 52203	

Pos	Description	Part Number	☆
R486	Resistor 8.20 kΩ 1% 1/8 W 100PPM 1206	4822 051 10822	
R488	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R489	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R490	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R491	Resistor 2.20 kΩ 1% 1/8 W 100PPM 1206	4822 051 52202	
R492	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R493	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R494	Resistor 2.20 kΩ 1% 1/8 W 100PPM 1206	4822 051 52202	
R495	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R496	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R497	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R498	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R499	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R500	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R501	Resistor 2.20 kΩ 1% 1/8 W 100PPM 1206	4822 051 52202	
R502	Resistor 2.20 kΩ 1% 1/8 W 100PPM 1206	4822 051 52202	
R503	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R504	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R508	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R514	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R515	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R516	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R517	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R518	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R519	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R520	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R521	Resistor 10.0 Ω 1% 1/8 W 100PPM 1206	4822 051 10109	
R522	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R523	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R524	Resistor 2.20 kΩ 1% 1/8 W 100PPM 1206	4822 051 52202	
R525	Resistor 220.0 Ω 1% 1/8 W 100PPM 1206	4822 051 52201	
R527	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R528	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R529	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R530	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R531	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R535	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R536	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R537	Resistor 120 Ω 1% 1/8 W 100PPM 1206	4822 051 10121	
R538	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R544	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R545	Resistor 47.0 kΩ 0.5% 1/8 W RC-03G 1206	5322 117 10857	
R546	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R547	Resistor 390 Ω 1% 1/8 W 100PPM 1206	4822 051 53901	
R548	Resistor 470.0 kΩ 0.5% 1/8 W RC-03G 1206	5322 117 10858	
R549	Resistor 470.0 kΩ 0.5% 1/8 W RC-03G 1206	5322 117 10858	
R550	Resistor 18.0 kΩ 1% 1/8 W 100PPM 1206	5322 117 10034	
R551	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R552	Resistor 2.20 kΩ 1% 1/8 W 100PPM 1206	4822 051 52202	
R553	Resistor 2.20 kΩ 1% 1/8 W 100PPM 1206	4822 051 52202	
R555	Resistor 10 MΩ 10% 1/4 W RC-01 1206	4822 051 10106	
R556	Resistor 47.0 kΩ 0.5% 1/8 W RC-03G 1206	5322 117 10857	
R557	Resistor 4.70 kΩ 1% 1/8 W 100PPM 1206	4822 051 54702	
R558	Resistor 10.0 Ω 1% 1/8 W 100PPM 1206	4822 051 10109	
R559	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R560	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R561	Resistor 270 Ω 1% 1/8 W 100PPM 1206	4822 051 10271	

Pos	Description	Part Number	☆
R562	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R563	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R564	Thermistor 2.2 kΩ 3% 1/4 W NTC	5322 116 30458	
R566	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R567	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R568	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R569	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R570	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R571	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R574	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R577	Resistor 220.0 Ω 1% 1/8 W 100PPM 1206	4822 051 52201	
R578	Resistor 220.0 Ω 1% 1/8 W 100PPM 1206	4822 051 52201	
R579	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R580	Resistor 3.30 kΩ 1% 1/8 W 100PPM 1206	4822 051 53302	
R581	Resistor 4.70 kΩ 1% 1/8 W 100PPM 1206	4822 051 54702	
R582	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R583	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R584	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R585	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R586	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R587	Thermistor 2.2 kΩ 3% 1/4 W NTC	5322 116 30458	
R588	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R589	Resistor 1.00 MΩ 1% 1/8 W 100PPM 1206	4822 051 10105	
R590	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R591	Resistor 1.00 MΩ 1% 1/8 W 100PPM 1206	4822 051 10105	
R592	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R593	Resistor 1.00 kΩ 1% 1/8 W 100PPM 1206	4822 051 51002	
R594	Resistor 820 Ω 1% 1/8 W 100PPM 1206	5322 116 82264	
R595	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R596	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R597	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R598	Resistor 47 Ω 1% 1/8 W 100PPM 1206	5322 116 80448	
R599	Resistor 2.20 kΩ 1% 1/8 W 100PPM 1206	4822 051 52202	
R600	Resistor 10.0 kΩ 1% 1/8 W 100PPM 1206	4822 051 51003	
R601	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R602	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R603	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R604	Resistor 33 Ω 1% 1/8 W 100PPM 1206	4822 051 10339	
R605	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R606	Resistor 100 kΩ 1% 1/8 W 100PPM 1206	4822 051 51004	
R607	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R608	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R609	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R610	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R611	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R612	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R613	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R614	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
R615	Resistor 100 Ω 1% 1/8 W 100PPM 1206	4822 051 51001	
R616	Resistor 56 Ω 1% 1/8 W 100PPM 1206	4822 051 10569	
T1	Transformer PM6680-Ser New PS	5322 148 20035	P
U1	IC CA3140M SO8	4822 209 62796	
U2	IC CA3140M SO8	4822 209 62796	
U02	IC PC74HC574T SO20	4822 209 60451	
U3	IC-KOMP AD96687BQ DUAL DIL16	5322 209 33098	
U5	IC-REG TL431C-LP TO92	4822 209 81397	
U6	IC-MIKROP N80C196KC16 SMD	5322 209 33105	

Pos	Description	Part Number	☆
U6	IC socket 68 POL 821574-1 F PLCC	5322 255 40677	
U7	IC 1.50 A LM317T TO-220	4822 209 80591	
U8	IC TL7770-50W	5322 209 30397	
U9	IC 64 KBIT TC5564PL-1 8KX8	5322 209 62104	
U10	IC-RAM CMOS TC55328P-35 256kB SMD	5322 209 33099	
U11	IC-RAM CMOS TC55328P-35 256kB SMD	5322 209 33099	
U12	IC-RAM CMOS TC55328P-35 256kB SMD	5322 209 33099	
U13	IC-RAM CMOS TC55328P-35 256kB SMD	5322 209 33099	
U14	IC-CMOS 74AC573 SO20 SMD	5322 209 33147	
U15	IC-CMOS 74AC573 SO20 SMD	5322 209 33147	
U16	IC socket 32 POL 644 018-3	5322 255 40921	
U16	IC-PROM PM6681 AM27H010-70DC	5322 209 52494	*
U17	IC socket 32 POL 644 018-3	5322 255 40921	
U17	IC-PROM PM6681 AM27H010-70DC	5322 209 52494	*
U18	IC PC74HC574T SO20	4822 209 60451	
U19	IC PC74HC574T SO20	4822 209 60451	
U20	IC-CMOS 74AC573 SO20 SMD	5322 209 33147	
U21	IC-CMOS 74AC11021 AND4 SO14 SMD	5322 209 33175	
U22	IC-CMOS 74AC11021 AND4 SO14 SMD	5322 209 33175	
U23	IC-CMOS 74AC11021 AND4 SO14 SMD	5322 209 33175	
U24	IC-CMOS 74AC11020 NAND4 SO14 SMD	5322 209 33174	
U25	IC-CMOS 74AC11020 NAND4 SO14 SMD	5322 209 33174	
U26	IC-CMOS 74AC08D 4XAND2 SO14 SMD	5322 209 33102	
U27	IC-CMOS 74AC08D 4XAND2 SO14 SMD	5322 209 33102	
U28	IC-CMOS 74AC86D 4XEXOR2 SO14 SMD	5322 209 33103	
U29	IC-CMOS 74AC11027 NOR3 SO16 SMD	5322 209 33176	
U30	IC-CMOS 74AC11027 NOR3 SO16 SMD	5322 209 33176	
U31	IC-CMOS 74AC02D 4XNOR2 SO14 SMD	5322 209 33101	
U32	IC-CMOS 74AC32D 4X0R2 SO14 SMD	5322 209 33104	
U33	IC-CMOS 74AC32D 4X0R2 SO14 SMD	5322 209 33104	
U34	IC-CMOS 74AC32D 4X0R2 SO14 SMD	5322 209 33104	
U35	IC-CMOS 74AC32D 4X0R2 SO14 SMD	5322 209 33104	
U36	IC PC74HC138T SO16	5322 209 73178	
U39	IC-CMOS 74AC11191 BIN-C SO20 SMD	5322 209 33177	
U41	IC-CMOS 74AC11191 BIN-C SO20 SMD	5322 209 33177	
U44	IC-CMOS 74AC573 SO20 SMD	5322 209 33147	
U45	IC-CMOS 74AC02D 4XNOR2 SO14 SMD	5322 209 33101	
U46	IC-CMOS 74AC02D 4XNOR2 SO14 SMD	5322 209 33101	
U47	IC-CMOS 74AC02D 4XNOR2 SO14 SMD	5322 209 33101	
U48	IC-CMOS 74AC02D 4XNOR2 SO14 SMD	5322 209 33101	
U49	IC-CMOS 74AC02D 4XNOR2 SO14 SMD	5322 209 33101	
U50	IC-CMOS 74AC02D 4XNOR2 SO14 SMD	5322 209 33101	
U51	IC-CMOS 74AC02D 4XNOR2 SO14 SMD	5322 209 33101	
U53	IC-CMOS 74AC11191 BIN-C SO20 SMD	5322 209 33177	
U54	IC-CMOS 74AC11027 NOR3 SO16 SMD	5322 209 33176	
U55	IC PC74HC574T SO20	4822 209 60451	
U56	IC-LSI CMOS PM6680-SER	5322 209 62844	R
U56	IC socket 44 POL PLCC	5322 255 41315	
U57	IC 1.50 A LM317T TO-220	4822 209 80591	
U58	IC-LSI BIPOL PM6681	5322 209 33097	R
U58	IC socket 68 POL 821574-1 F PLCC	5322 255 40677	
U59	IC 75uV LÅG OFFSET DIL-8	5322 209 62119	
U60	IC PC74HC4353T SO20	4822 209 62805	
U61	IC 75uV LÅG OFFSET DIL-8	5322 209 62119	
U62	IC 75uV LÅG OFFSET DIL-8	5322 209 62119	
U63	IC-DAC 12BIT AD7545AKN DIL20	5322 209 62107	
U64	IC-DAC 12BIT AD7545AKN DIL20	5322 209 62107	
U65	IC 75uV LÅG OFFSET DIL-8	5322 209 62119	
U66	IC 75uV LÅG OFFSET DIL-8	5322 209 62119	

Pos	Description	Part Number	☆
U67	IC NE532D DUAL SO-8	5322 209 71553	
U69	Heat sink 16$K/W TO220	5322 255 41313	P
U69	IC 12 V UA7812UC 1A TO-220	5322 209 86176	
U70	IC 1.50 A LM317T TO-220	4822 209 80591	
U71	IC-REG TL431C-LP TO92	4822 209 81397	
U72	IC 75uV LÅG OFFSET DIL-8	5322 209 62119	
U73	Heat sink 16$K/W TO220	5322 255 41313	P
U73	IC 1.50 A LM337T TO-220	5322 209 81236	
U74	IC-REG TL431C-LP TO92	4822 209 81397	
U75	IC CA3140M SO8	4822 209 62796	
U77	IC NE532D DUAL SO-8	5322 209 71553	
U78	IC P8291A TALK/LISTEN	5322 209 81264	
U79	IC SN75161AN	5322 209 81842	
U80	IC SN75160AN	5322 209 81807	
U82	IC-CMOS 74AC11021 AND4 SO14 SMD	5322 209 33175	
U84	IC-DIG ECL 100304PC PDIP24	5322 209 33638	
U85	IC-DIG ECL 100331QC PCC28	5322 209 33604	
U86	IC-REF 2.50 V MC1403U DIL-8	5322 209 82864	
U87	IC-CMOS 74AC11020 NAND4 SO14 SMD	5322 209 33174	
U88	IC-BUS TRANSEIV 75ALS176D SO-8 SMD	5322 209 33171	
U90	Optocoupler CNX82A SEMKO SOT231	4822 130 10025	
U91	IC-ANA SMPS CTR UC3842AD SO14	5322 209 33169	
U92	IC-REF 2.5V TL431I-D SO8	5322 209 62422	
U93	IC-CMOS 74AC02D 4XNOR2 SO14 SMD	5322 209 33101	
U94	IC-CMOS 74AC86D 4XEXOR2 SO14 SMD	5322 209 33103	
U95	IC NE532D DUAL SO-8	5322 209 71553	
U97	IC- 14C88M SO14	5322 209 33108	
U98	IC-CMOS 74AC08D 4XAND2 SO14 SMD	5322 209 33102	
U99	IC NE532D DUAL SO-8	5322 209 71553	
V1	Transistor BF513 .03A20V SOT23	4822 130 60686	
V2	Transistor BF513 .03A20V SOT23	4822 130 60686	
V3	Transistor BFS17 .05A 15V SOT23	5322 130 40781	
V4	Transistor BFS17 .05A 15V SOT23	5322 130 40781	
V8	Transistor BFS17 .05A 15V SOT23	5322 130 40781	
V9	Transistor BSR12 0.1A 15V SOT23	5322 130 44743	
V12	Transistor BSR12 0.1A 15V SOT23	5322 130 44743	
V14	Transistor BSR12 0.1A 15V SOT23	5322 130 44743	
V15	Transistor BC847B .1A45V SOT23	4822 130 60511	
V16	Transistor BC857B .1A45V SOT23	5322 130 60508	
V17	Transistor BC857B .1A45V SOT23	5322 130 60508	
V18	Transistor BC369 1A 20V TO92	5322 130 44593	
V19	Transistor BFS17 .05A 15V SOT23	5322 130 40781	
V20	Transistor BFS17 .05A 15V SOT23	5322 130 40781	
V21	Transistor BF513 .03A20V SOT23	4822 130 60686	
V22	Transistor 25 MA BFR92A 20V SOT23	5322 130 60647	
V23	Transistor BFG97 0.1A 15V SO223	4822 130 63069	
V25	Transistor 25 MA BFR92A 20V SOT23	5322 130 60647	
V26	Transistor BFG97 0.1A 15V SO223	4822 130 63069	
V27	Transistor BFS17 .05A 15V SOT23	5322 130 40781	
V28	Transistor 25 MA BFR92A 20V SOT23	5322 130 60647	
V29	Transistor BFG97 0.1A 15V SO223	4822 130 63069	
V31	Transistor 25 MA BFR92A 20V SOT23	5322 130 60647	
V32	Transistor BFG97 0.1A 15V SO223	4822 130 63069	
V33	Transistor BFS17 .05A 15V SOT23	5322 130 40781	
V40	Transistor BFS17 .05A 15V SOT23	5322 130 40781	
V41	Transistor BFS17 .05A 15V SOT23	5322 130 40781	
V42	Transistor BFS17 .05A 15V SOT23	5322 130 40781	
V43	Transistor BSV52 0.1A 12V SOT23	5322 130 44336	
V44	Transistor BC847B .1A45V SOT23	4822 130 60511	

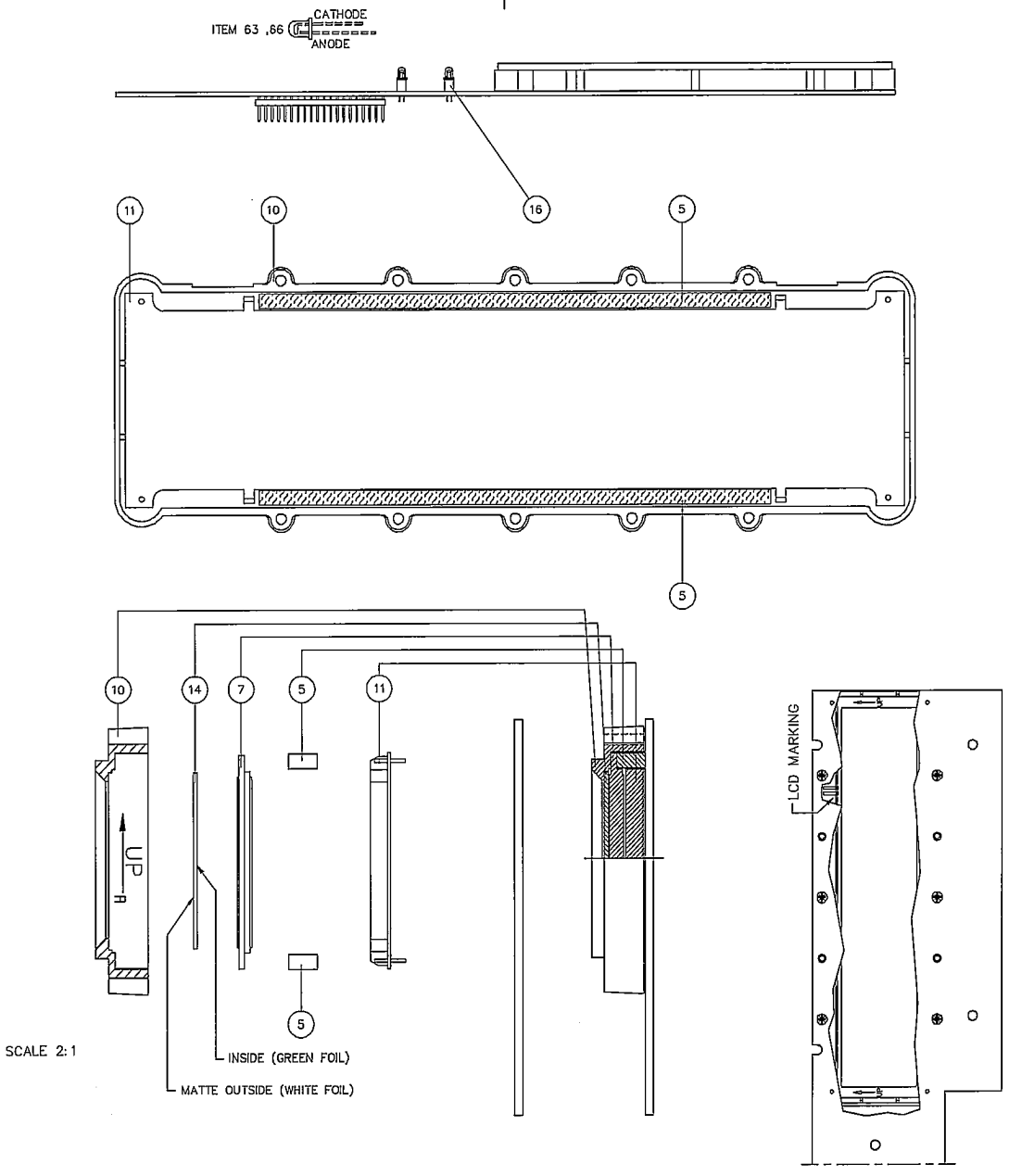
Pos	Description	Part Number	☆
V45	Transistor BC847B .1A45V SOT23	4822 130 60511	
V46	Transistor BC847B .1A45V SOT23	4822 130 60511	
V47	Transistor BC847B .1A45V SOT23	4822 130 60511	
V48	Transistor BC847B .1A45V SOT23	4822 130 60511	
V49	Transistor BC847B .1A45V SOT23	4822 130 60511	
V50	Transistor BC847B .1A45V SOT23	4822 130 60511	
V51	Transistor BC847B .1A45V SOT23	4822 130 60511	
V52	Transistor BC847B .1A45V SOT23	4822 130 60511	
V53	Transistor BC847B .1A45V SOT23	4822 130 60511	
V54	Transistor BC847B .1A45V SOT23	4822 130 60511	
V55	Heat sink 13.5$K/W TO220	5322 255 41314	P
V55	Clip ELFA 2201	5322 405 91687	P
V55	Transi-pow MOS 2A BUK446-800A SOT186	5322 130 63535	
V56	Transistor 0.50 A BC807-25 45V SOT23	5322 130 60845	
V57	Transistor 0.50 A BC817-25 45V SOT23	4822 130 42804	
V58	Transistor 0.50 A BC817-25 45V SOT23	4822 130 42804	

Pos	Description	Part Number	☆
V59	Transistor 0.50 A BC817-25 45V SOT23	4822 130 42804	
V60	Transistor 0.50 A BC817-25 45V SOT23	4822 130 42804	
V61	Transistor BC847B .1A45V SOT23	4822 130 60511	
V62	Transistor BCP51 1.5A 45V SOT223	5322 130 62639	
V63	Transistor 0.50 A BC817-25 45V SOT23	4822 130 42804	
V64	Transistor 0.50 A BC807-25 45V SOT23	5322 130 60845	
V65	Transistor BC847B .1A45V SOT23	4822 130 60511	
V66	Transistor BC857B .1A45V SOT23	5322 130 60508	
V67	Transistor BFS17 .05A 15V SOT23	5322 130 40781	
V68	Transistor BFS17 .05A 15V SOT23	5322 130 40781	
V69	Transistor BC847B .1A45V SOT23	4822 130 60511	
V70	Transistor BC847B .1A45V SOT23	4822 130 60511	
V71	Transistor BC847B .1A45V SOT23	4822 130 60511	
X2	Connector 3 POL F095 single row	5322 290 60445	
X4	Connector 3 POL F095 single row	5322 290 60445	

Front board

Pos	Description	Part Number	☆
	PC-B 2 assy	5322 218 70109	P
5	Zebra strip	5322 267 70294	R
7	LCD display	5322 130 90889	R
10	LCD rim	5322 464 90667	R
11	Backlight	5322 130 82201	R
14	Window LCD	5322 381 11136	P
16	LED spacer	5322 255 41228	
32	Screw RX-PT Z 2-28X8 FZB	4822 502 30081	P
C201	Capacitor 10 nF 20% 50V X7R 0805	5322 122 34098	
C202	Capacitor 10 nF 20% 50V X7R 0805	5322 122 34098	
D201	LED 3mm HLMP-K150 Red 1 mA	5322 130 81921	
D202	LED 3mm Yellow 590nm 4-8MCD/1 0mA	4822 130 30953	R

Pos	Description	Part Number	☆
D203	LED 3mm Yellow 590nm 4-8MCD/10 mA	4822 130 30953	R
D204	LED 3mm Yellow 590nm 4-8MCD/10 mA	4822 130 30953	R
DL100	Backlight	5322 130 82201	R
E201	LCD display	5322 130 90889	R
P204	Connector 40 POL TMH-120-01-L-DW	5322 265 51295	
R201	Resistor 220 kΩ 1% 1/8 W 100PPM 1206	4822 051 52204	
R202	Resistor 390 Ω 1% 1/8 W 100PPM 1206	4822 051 53901	
R203	Resistor 390 Ω 1% 1/8 W 100PPM 1206	4822 051 53901	
R204	Resistor 4.7 Ω 10% 1/4 W RC-01 1206	4833 051 10478	
R205	Resistor 4.7 Ω 10% 1/4 W RC-01 1206	4833 051 10478	
U201	IC PCF8576T VSO56	5322 209 11129	
U202	IC PCF8576T VSO56	5322 209 11129	



Pos	Description	Part Number	☆
	Cable assy,	5322 321 22313	
	Shield cover,	5322 447 91673	P
	Shield,	5322 447 91672	P
BU1	Connector, R 114426 SMB	5322 267 60199	
BU7	Connector, 16pin, F095 90deg d. Row	5322 267 74032	
C1	Capacitor, 100 pF, 5% 50V NP0 0805	5322 122 32531	
C2	Capacitor, 1 nF, 20% 50V X7R 0805	5322 122 34123	
C3	Capacitor, 1 nF, 20% 50V X7R 0805	5322 122 34123	
C4	Capacitor, 10 nF, 20% 50V X7R 0805	5322 122 34098	
C5	Capacitor, 1 nF, 20% 50V X7R 0805	5322 122 34123	
C6	Capacitor, 1 nF, 20% 50V X7R 0805	5322 122 34123	
C7	Capacitor, 47 pF, 5% 50V NP0 0805	5322 122 32452	
C8	Capacitor, 1 nF, 20% 50V X7R 0805	5322 122 34123	
C10	Capacitor, 4.7 pF, 5% 50V NP0 0805	5322 122 32287	
C11	Capacitor, 1 nF, 20% 50V X7R 0805	5322 122 34123	
C12	Capacitor, 1 nF, 20% 50V X7R 0805	5322 122 34123	
C13	Capacitor, 15 pF, 5% 50V NP0 0805	5322 122 33869	
C14	Capacitor, 1 nF, 20% 50V X7R 0805	5322 122 34123	
C16	Capacitor, 1 pF, 5% 50V NP0 0805	5322 122 32447	
C17	Capacitor, 1 nF, 20% 50V X7R 0805	5322 122 34123	
C18	Capacitor, 10 nF, 20% 50V X7R 0805	5322 122 34098	
C19	Capacitor, 10 nF, 20% 50V X7R 0805	5322 122 34098	
C20	Capacitor, 10 nF, 20% 50V X7R 0805	5322 122 34098	
C21	Capacitor, 10 nF, 20% 50V X7R 0805	5322 122 34098	
C22	Capacitor, 10 nF, 20% 50V X7R 0805	5322 122 34098	
C23	Capacitor, 15 F, 20%6.3V 6.0X3.2 mold	5322 124 10684	
C24	Capacitor, 1 nF, 20% 50V X7R 0805	5322 122 34123	
C25	Capacitor, 10 nF, 20% 50V X7R 0805	5322 122 34098	
C26	Capacitor, 10 nF, 20% 50V X7R 0805	5322 122 34098	
C27	Capacitor, 10 nF, 20% 50V X7R 0805	5322 122 34098	
C31	Capacitor, 1 pF, 5% 50V NP0 0805	5322 122 32447	
C32	Capacitor, 3.3 pF, 5% 50V NP0 0805	5322 122 32286	
C34	Capacitor, 3.3 pF, 5% 50V NP0 0805	5322 122 32286	
C35	Capacitor, 22 pF, 5% 50V NP0 0805	5322 122 32658	
C36	Capacitor, 10 nF, 20% 50V X7R 0805	5322 122 34098	
C37	Capacitor, 2.2 pF, 5% 50V NP0 0805	5322 122 33063	
C38	Capacitor, 10 nF, 20% 50V X7R 0805	5322 122 34098	
C39	Capacitor, 1 nF, 20% 50V X7R 0805	5322 122 34123	
C40	Capacitor, 1 nF, 20% 50V X7R 0805	5322 122 34123	
GR3	Diode, 0.03A, BAT17 SOT23	5322 130 31544	
GR4	Diode, 0.03A, BAT17 SOT23	5322 130 31544	
GR5	Diode, 0.03A, BAT17 SOT23	5322 130 31544	
GR6	Diode, 0.03A, BAT17 SOT23	5322 130 31544	
GR7	Diode, 0.03A, BAT17 SOT23	5322 130 31544	
GR8	Diode, 0.1A, BAV99 SOT23	5322 130 34337	
GR9	Diode, 0.03A, BAT17 SOT23	5322 130 31544	
GR11	Diode, BAR 16-1 SOT23	5322 130 80246	
GR15	Diode, 0.03A, BAT17 SOT23	5322 130 31544	
GR16	Diode, 0.1A, BAV99 SOT23	5322 130 34337	
GR17	Diode, 0.1A, BAV99 SOT23	5322 130 34337	
GR18	Diode, 0.1A, BAV99 SOT23	5322 130 34337	
IC1	IC, 1.2 GHz, UPC1652G SO-8 VAR	5322 209 71557	
IC2	IC, 1.3 GHz, U833BS	5322 209 61399	
IC3	IC, NE532D DUAL SO-8	5322 209 71553	
L1	Choke, 0.1H, 10% MLF3216DR10K	5322 157 52986	
L7	Choke, 0.1H, 10% MLF3216DR10K	5322 157 52986	
L8	Choke, 0.1H, 10% MLF3216DR10K	5322 157 52986	
L9	Choke, 0.1H, 10% MLF3216DR10K	5322 157 52986	
R1	Resistor, 470 Ω, 1% 1/8W 100PPM 1206	5322 116 80444	
R2	Resistor, 470 Ω, 1% 1/8W 100PPM 1206	5322 116 80444	
R3	Resistor, 470 Ω, 1% 1/8W 100PPM 1206	5322 116 80444	
R4	Resistor, 22 Ω, 1% 1/8W 100PPM 1206	4822 051 10229	
R5	Resistor, 22 Ω, 1% 1/8W 100PPM 1206	4822 051 10229	
R6	Resistor, 22 Ω, 1% 1/8W 100PPM 1206	4822 051 10229	
R7	Resistor, 22 Ω, 1% 1/8W 100PPM 1206	4822 051 10229	
R8	Resistor, 22 Ω, 1% 1/8W 100PPM 1206	4822 051 10229	
R9	Resistor, 22 Ω, 1% 1/8W 100PPM 1206	4822 051 10229	
R10	Resistor, 270 Ω, 1% 1/8W 100PPM 1206	4822 051 10271	
R11	Resistor, 330 Ω, 1% 1/8W 100PPM 1206	5322 116 80438	
R12	Resistor, 330 Ω, 1% 1/8W 100PPM 1206	5322 116 80438	
R13	Resistor, 8.2 Ω, 10% 1/4W RC-01 1206	4822 051 10828	
R14	Resistor, 150 Ω, 1% 1/8W 100PPM 1206	5322 116 80431	
R15	Resistor, 8.2 Ω, 10% 1/4W RC-01 1206	4822 051 10828	
R16	Resistor, 220 Ω, 1% 1/8W 100PPM 1206	5322 116 80433	
R19	Resistor, 33 Ω, 1% 1/8W 100PPM 1206	4822 051 10339	
R20	Resistor, 10 Ω, 1% 1/8W 100PPM 1206	4822 051 10109	
R21	Resistor, 47 Ω, 1% 1/8W 100PPM 1206	5322 116 80448	
R22	Resistor, 47 Ω, 1% 1/8W 100PPM 1206	5322 116 80448	
R24	Resistor, 180 Ω, 1% 1/8W 100PPM 1206	4822 051 10181	
R25	Resistor, 2.7 kΩ , 1% 1/8W 100PPM 1206	5322 116 80437	
R26	Resistor, 47 kΩ , 1% 1/8W 100PPM 1206	5322 116 80446	
R27	Resistor, 2.2 kΩ , 1% 1/8W 100PPM 1206	5322 116 80434	
R28	Resistor, 270 Ω, 1% 1/8W 100PPM 1206	4822 051 10271	
R29	Resistor, 330 Ω, 1% 1/8W 100PPM 1206	5322 116 80438	
R30	Potentiometer, 1 kΩ , 10% 72X	5322 101 14299	
R31	Resistor, 47 kΩ , 1% 1/8W 100PPM 1206	5322 116 80446	
R32	Resistor, 4.7 kΩ , 1% 1/8W 100PPM 1206	5322 116 80445	
R33	Resistor, 3.3 kΩ, 1% 1/8W 100PPM 1206	5322 116 80439	
R35	Resistor, 220 kΩ, 1% 1/8W 100PPM 1206	5322 116 80436	
R38	Resistor, 1 kΩ, 1% 1/8W 100PPM 1206	5322 116 80427	
R39	Resistor, 470 kΩ, 1% 1/8W 100PPM 1206	5322 116 80447	
R40	Resistor, 33 kΩ, 1% 1/8W 100PPM 1206	5322 116 80441	
R41	Resistor, 560 Ω, 1% 1/8W 100PPM 1206	4822 051 10561	
R42	Resistor, 27 Ω, 1% 1/8W 100PPM 1206	5322 116 82262	
R43	Resistor, 1.8 kΩ, 1% 1/8W 100PPM 1206	4822 051 10182	
R44	Resistor, 3.3 kΩ, 1% 1/8W 100PPM 1206	5322 116 80439	
R47	Resistor, 470 Ω, 1% 1/8W 100PPM 1206	5322 116 80444	
R48	Resistor, 82 Ω, 1% 1/8W 100PPM 1206	4822 051 10829	
R52	Resistor, 47 kΩ, 1% 1/8W 100PPM 1206	5322 116 80446	
R53	Resistor, 10 kΩ, 1% 1/8W 100PPM 1206	5322 116 80428	
R55	Resistor, 33 Ω, 1% 1/8W 100PPM 1206	4822 051 10339	
R56	Resistor, 22 Ω, 1% 1/8W 100PPM 1206	4822 051 10229	
R57	Resistor, 100 Ω, 1% 1/8W 100PPM 1206	5322 116 80426	
R58	Resistor, 1 kΩ, 1% 1/8W 100PPM 1206	5322 116 80427	
R59	Resistor, 1 kΩ, 1% 1/8W 100PPM 1206	5322 116 80427	
R60	Resistor, 120 Ω, 1% 1/8W 100PPM 1206	4822 051 10121	
R61	Resistor, 120 Ω, 1% 1/8W 100PPM 1206	4822 051 10121	
R62	Resistor, 330 Ω, 1% 1/8W 100PPM 1206	5322 116 80438	

Pos	Description	Part Number	☆
R63	Resistor, 100 Ω, 1% 1/8W 100PPM 1206	5322 116 80426	
R64	Resistor, 470 kΩ, 1% 1/8W 100PPM 1206	5322 116 80447	
R65	Resistor, 220 kΩ, 1% 1/8W 100PPM 1206	5322 116 80436	
R66	Resistor, 0 Ω, RC-01 1206	4822 051 10008	
TP3	Flat Pin, 2.8mm, E184/8 lesa sn band	5322 290 34064	
TP4	Flat Pin, 2.8mm, E184/8 lesa sn band	5322 290 34064	
TS1	Transistor, BFQ67 SOT23	5322 130 42567	
TS2	Transistor, BFQ67 SOT23	5322 130 42567	

Pos	Description	Part Number	☆
TS3	Transistor, BC847B .1A45V SOT23	4822 130 60511	
TS4	Transistor, BC847B .1A45V SOT23	4822 130 60511	
TS5	Transistor, BFS17 .05A 15V SOT23	5322 130 40781	
TS6	Transistor, BFS17 .05A 15V SOT23	5322 130 40781	
TS7	Transistor, BFS17 .05A 15V SOT23	5322 130 40781	
TS8	Transistor, BFT92 25MA 15V SOT23	5322 130 44711	
TS9	Transistor, BC847B .1A45V SOT23	4822 130 60511	
TS10	Transistor, BC847B .1A45V SOT23	4822 130 60511	

Pos	Description	Part Number	☆
	Screw, MRT-KOMBI 3X06 STFZ	4822 502 11658	P
	Spring Washer, KBA 3.2 ST FZ DIN137	4822 530 80173	P
BU1	Connector, 10 pin, 22-14-2104 4455-BC	5322 267 50336	
C1	Capacitor, 65 pF, 5,5-65pF 100V	4822 125 50017	
C2	Capacitor, 15 F, 20% 16V SOLID AL	4822 124 20977	
KT1	Oscillator, 10 MHz, TCXO	5322 216 94047	R
R1	Resistor, 147, 1% 1/2 W MRS25	4822 050 21471	
TS1	Transistor, BF245C.025A 30V TO92	4822 130 41065	

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Chapter 8

Schematic Diagrams

How to Read the Diagrams

This chapter contains circuit diagrams and component layout information.

Each diagram contains a list of the ICs used. These lists indicates the connections that are not shown in the diagram, such as GND and supply voltages.

Signals

The signals in the counter are named after what they do, e.g. LEAD-EDGE is used as control current to the leading edge circuits.

Two different types of arrows are used to mark references for continued connection somewhere else in the diagram.

This arrow is used if the reference is directed to a point located on the same page.

This arrow is used if the reference is directed to a point located on another page. The example means that the point is on sheet 1, coordinate A1.

Colored Areas

The coloured areas in the diagrams represent following functions:

= Integrated circuits

= Trim points, test points or jumpers

= Connectors

Circuit Symbols

The diagrams are computer drawn. The symbols conform to IEC standards. These symbols are designed to be logical and easy to read.

The component number is written above the symbol.

Inside the symbol at the top is an abbreviated description of the circuit's function.

Pin numbers are written outside the symbol and, if the circuit is complex, the pin functions are written inside.

A small circle on a pin indicates that the input/output inverts the signal.

The component name is written below the symbol.

The signal flow through the circuit is always from left to right.

Resistors, Capacitors, Diodes, Transistors and Other Components.

These components are similar to the old-fashioned, hand-drawn symbols. They have their component number above and their value or component name below.

A resistor contained in a resistor network has a frame drawn around it and one of the pin numbers is written to the left or below it.

Component Numbers

Letters	Components
B	Crystals and crystal filters
C	Capacitors
D	Diodes
F	Fuses
G	Batteries
J	Jumpers and connectors
K	Relays
L	Coils
P	Connectors
R	Resistors
U	IC;s
V	Transistors
X	Test points

The numbers are only sequential numbers.

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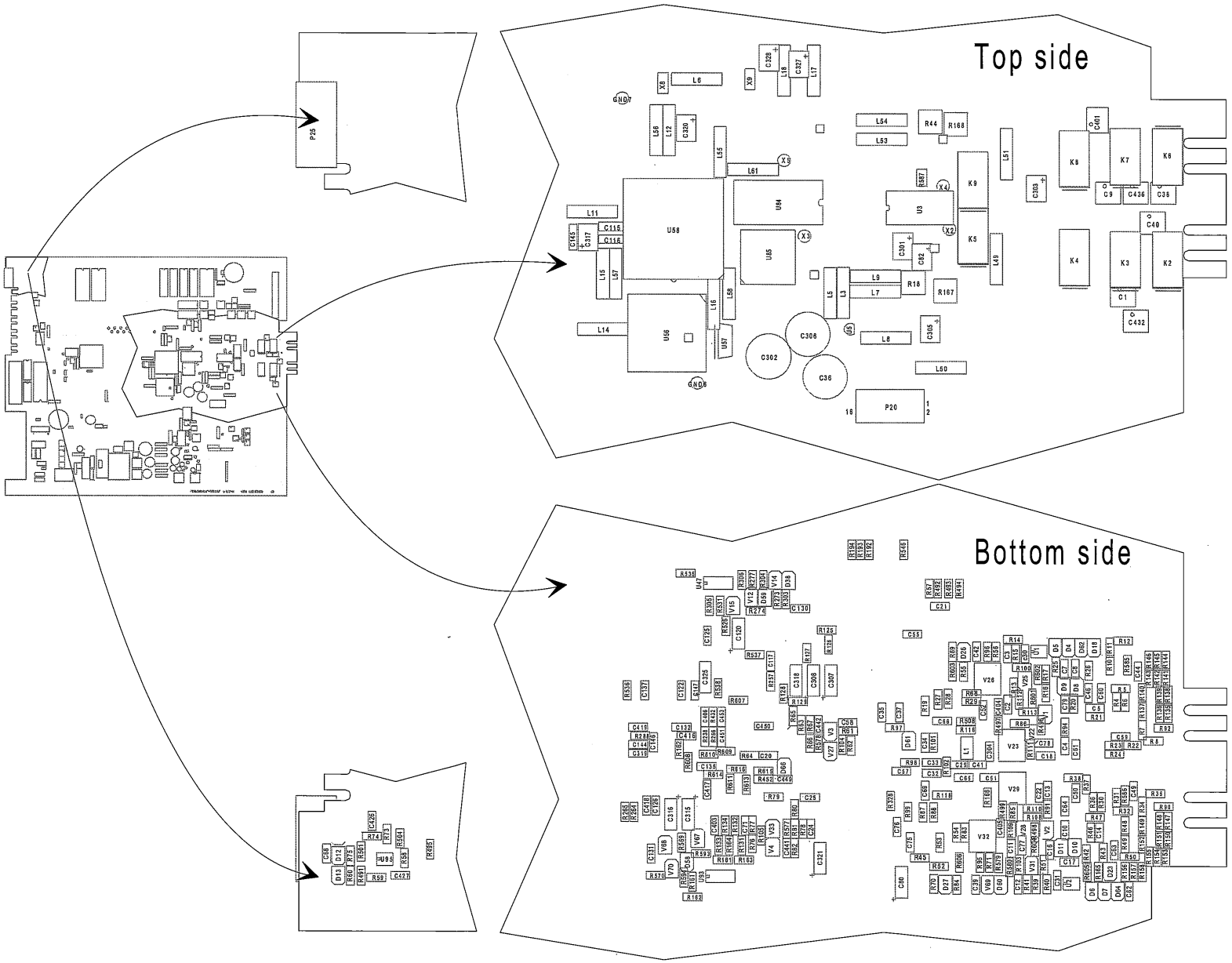
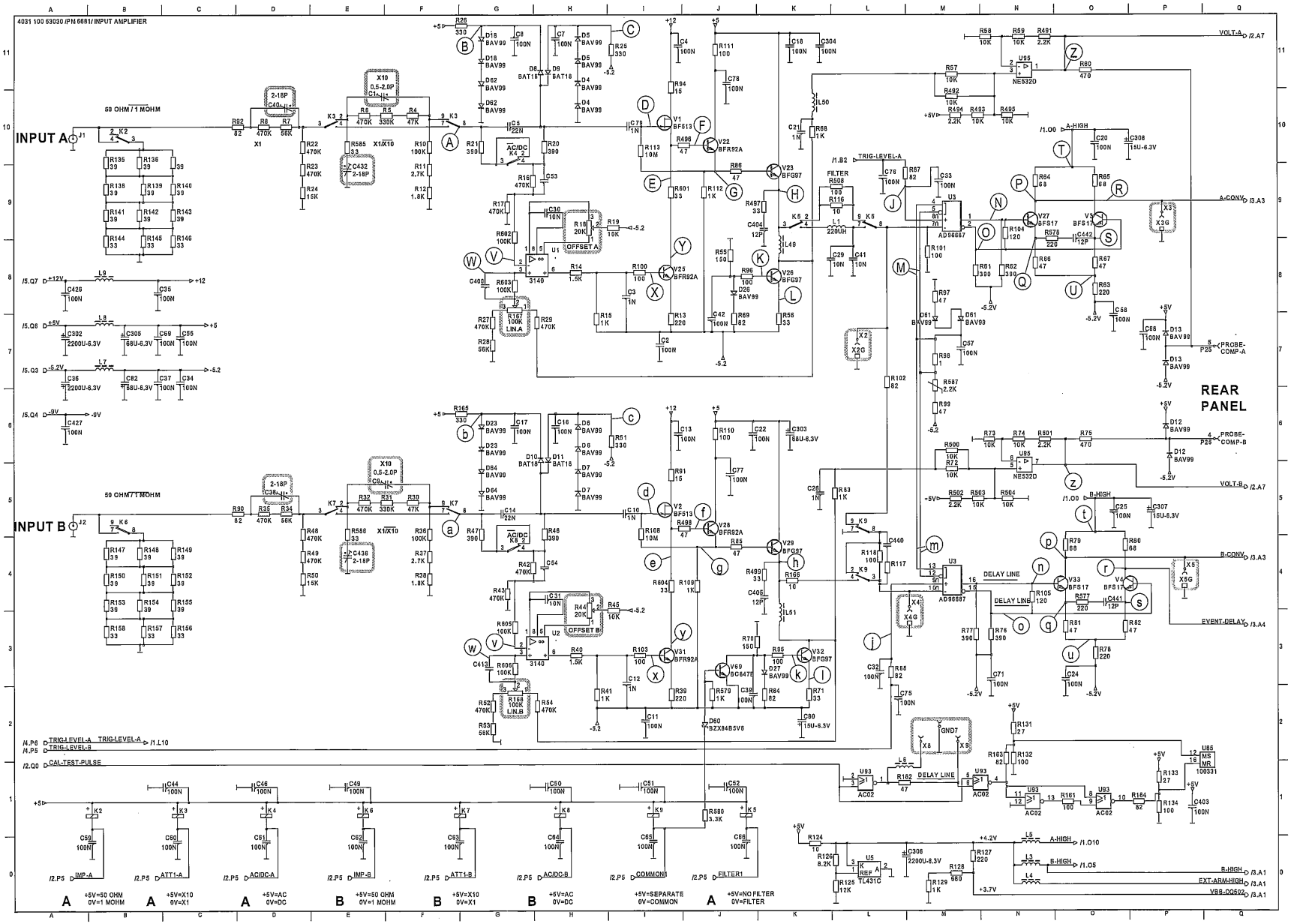
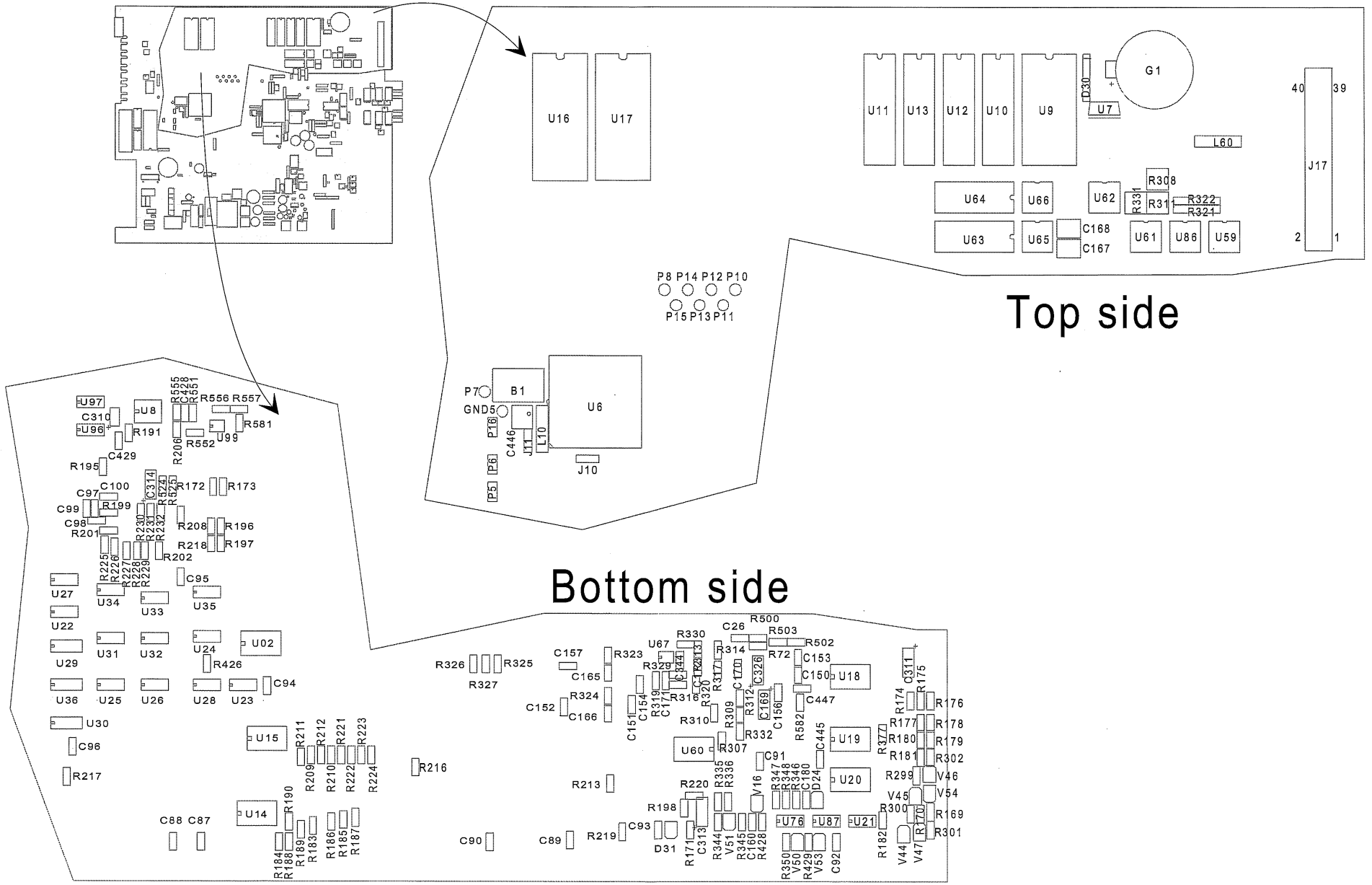
Basic board, *Component layout*

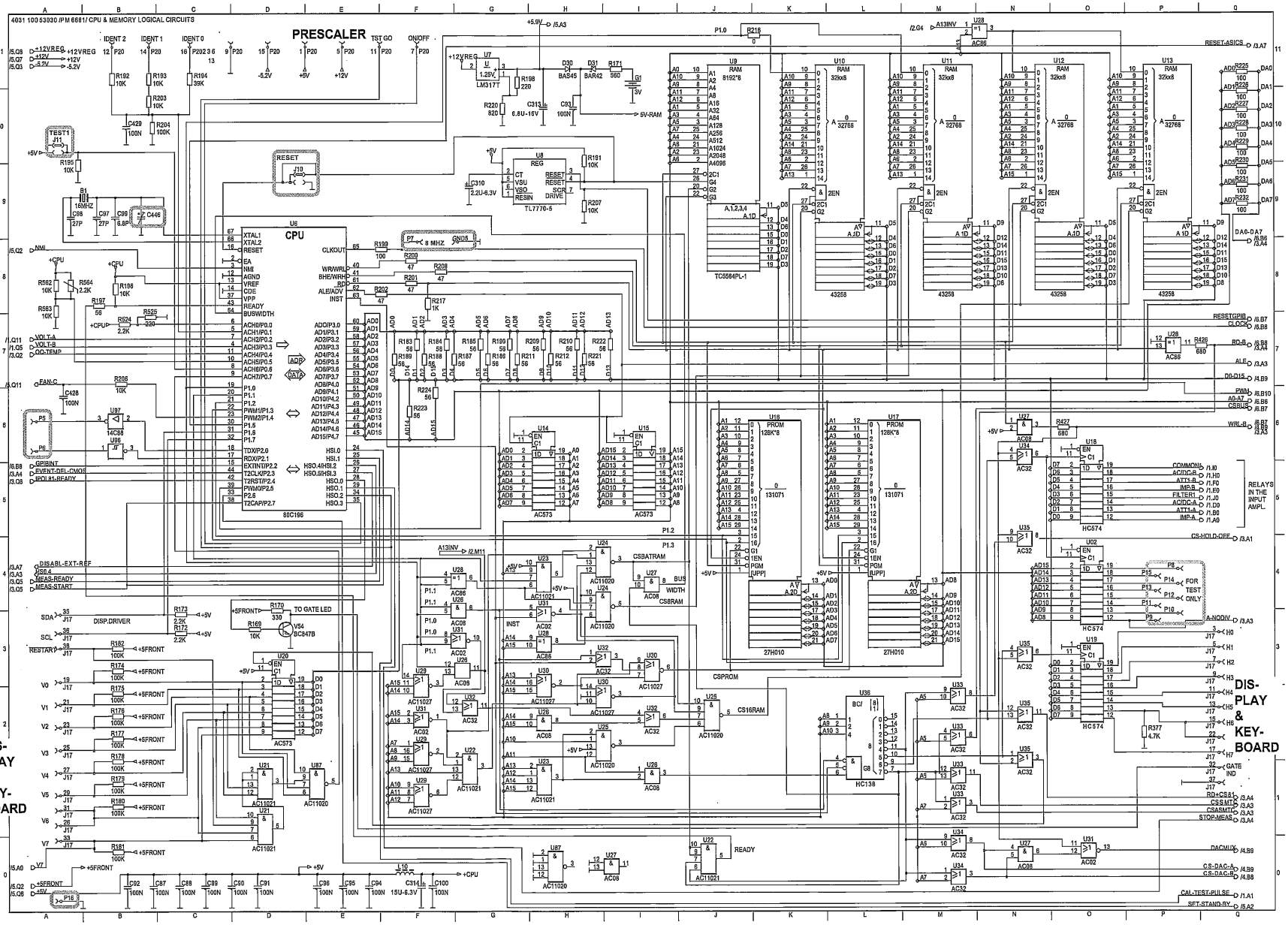


Input amplifier, Unit 1 sheet 1(6)



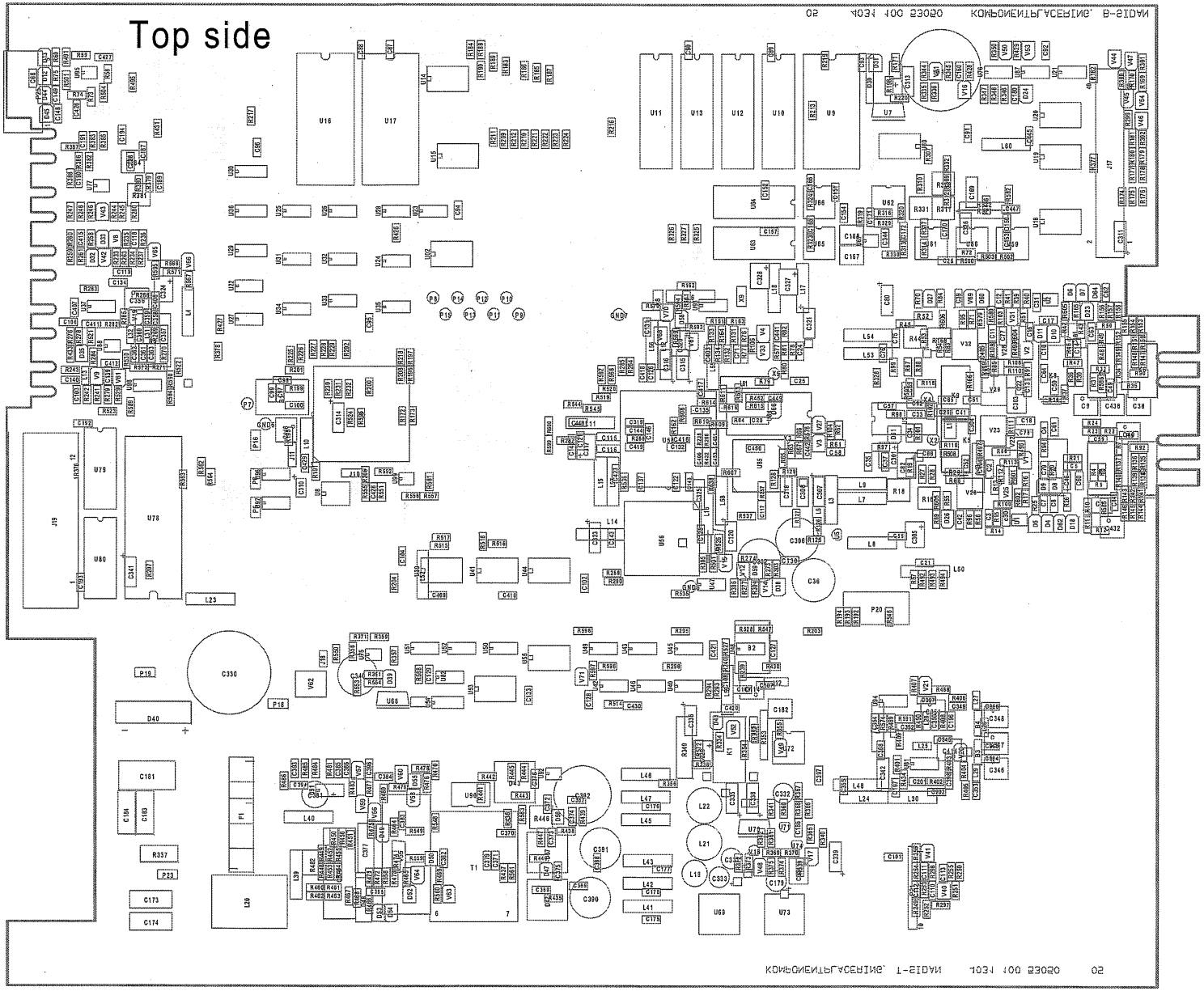
Basic board, Component layout

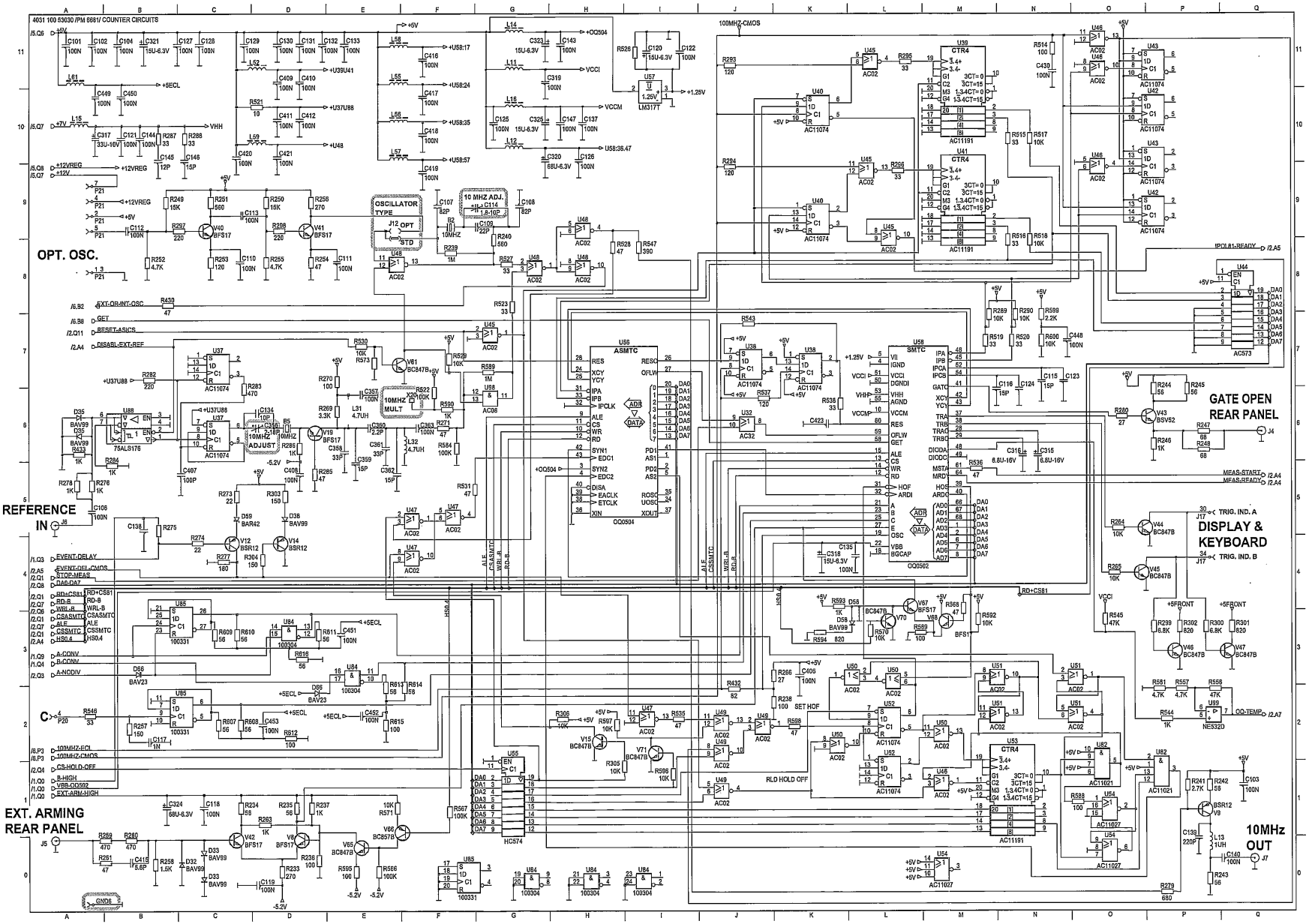



4031 100 53930 /PM 6681/ CPU & MEMORY LOGICAL CIRCUITS
PRESCALER
IDENT 2
IDENT 1
IDENT 0
TST GO
ONOFF
CPU
80C196
RESET
TEST1
DISP.DRIVER
DISABL-EXT-REF
MEAS-READY
MEAS-START
TO GATE LED
RESET-ASICS
RESETGPIB
CLOCK
DA0-DA7
RD-B
ALE
WRL-B
PWM
A0-A7
CSBUS
RELAYS IN THE INPUT AMPL
COMMON-B
AC/DC-B
ATT1-B
IMP-B
FILTER1
AC/DC-A
ATT1-A
IMP-A
CS-HOLD-OFF
FOR TEST ONLY
A-NODIV
GATE IND
RD+CSA1
CSSMTC
CSASMTC
STOP-MEAS
DACMUX
CS-DAC-A
CS-DAC-B
CAL-TEST-PULSE
SFT-STAND-BY
DISPLAY & KEYBOARD
CSPROM
CS16RAM
CSBATRAM
CS8RAM
READY
INST
RESTART
SDA
SCL
VOLT-A
VOLT-B
OIO-TEMP
FAN-C
NMI
+12VREG
+5V
-5.2V
+5FRONT
+CPU
5V-RAM

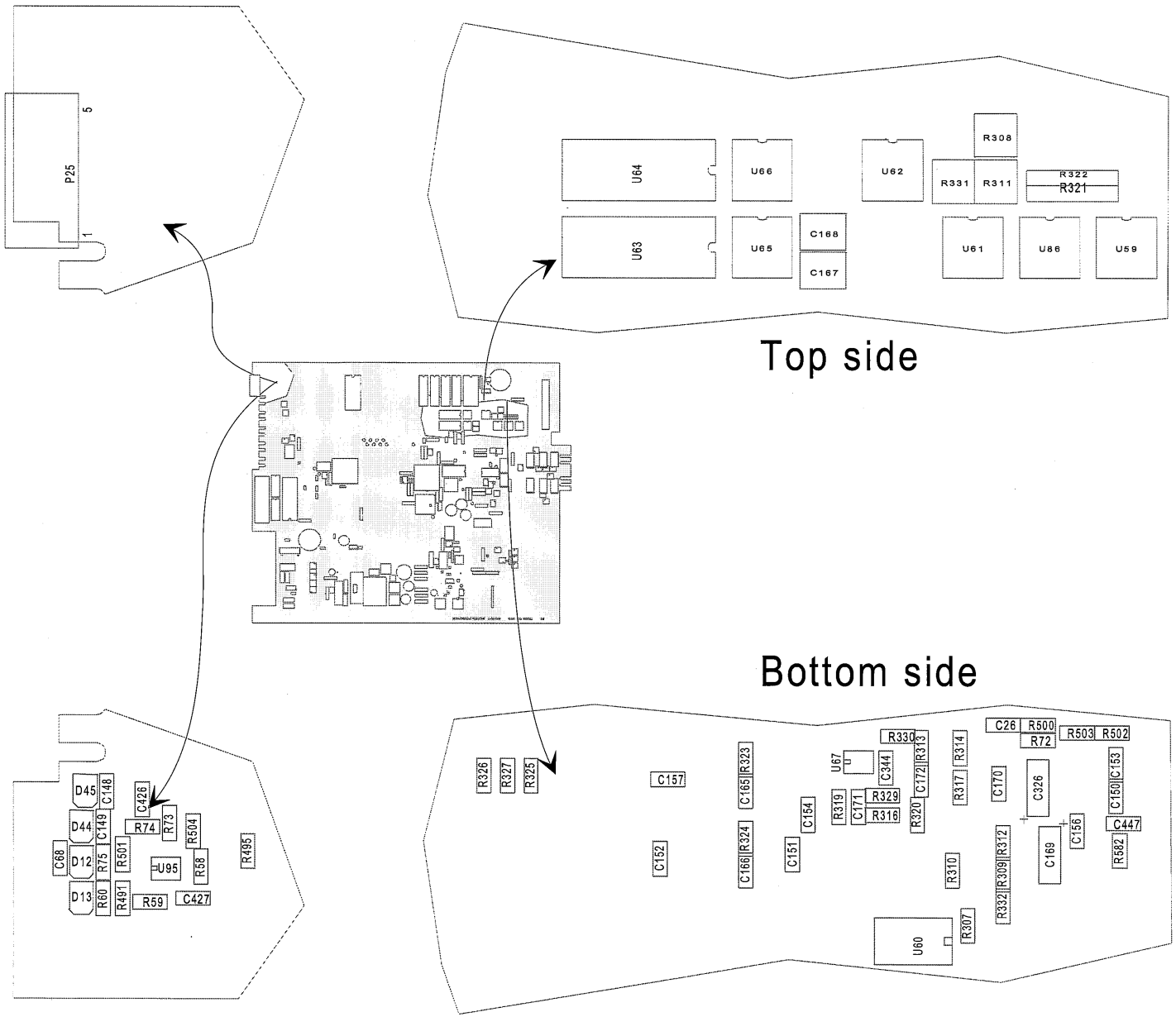
Basic board, Component layout

Shadowed components mounted on the bottom side of the PCA

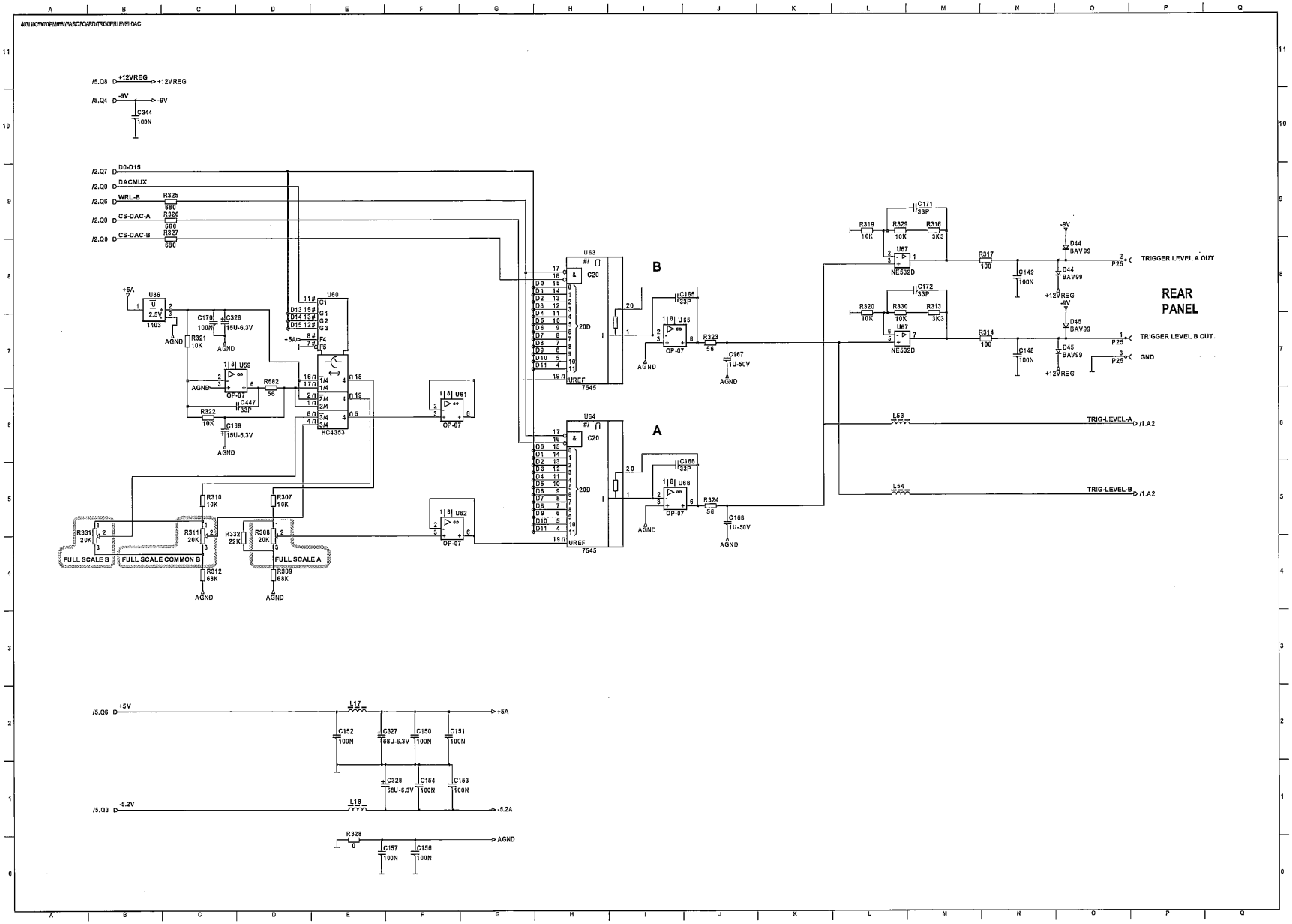



4031 100 83030 /PM 6681/ COUNTER CIRCUITS
OPT. OSC.
REFERENCE IN
EXT. ARMING REAR PANEL
GATE OPEN REAR PANEL
DISPLAY & KEYBOARD
10MHz OUT
100MHZ-CMOS
ASMTC
SMTC
OQ0504
OQ0502
CTR4
RLD HOLD OFF
SET HOF

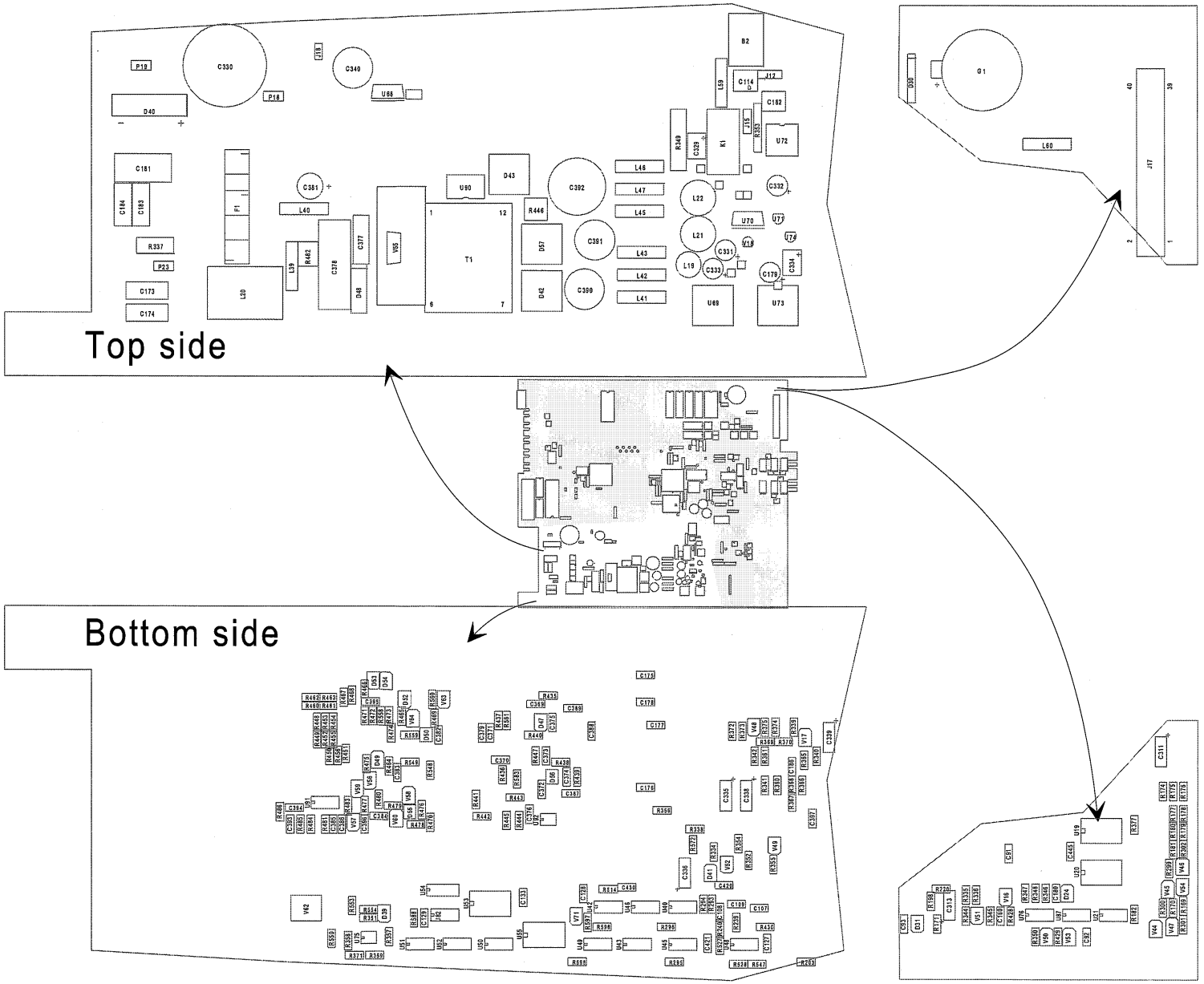
Basic board, *Component layout*

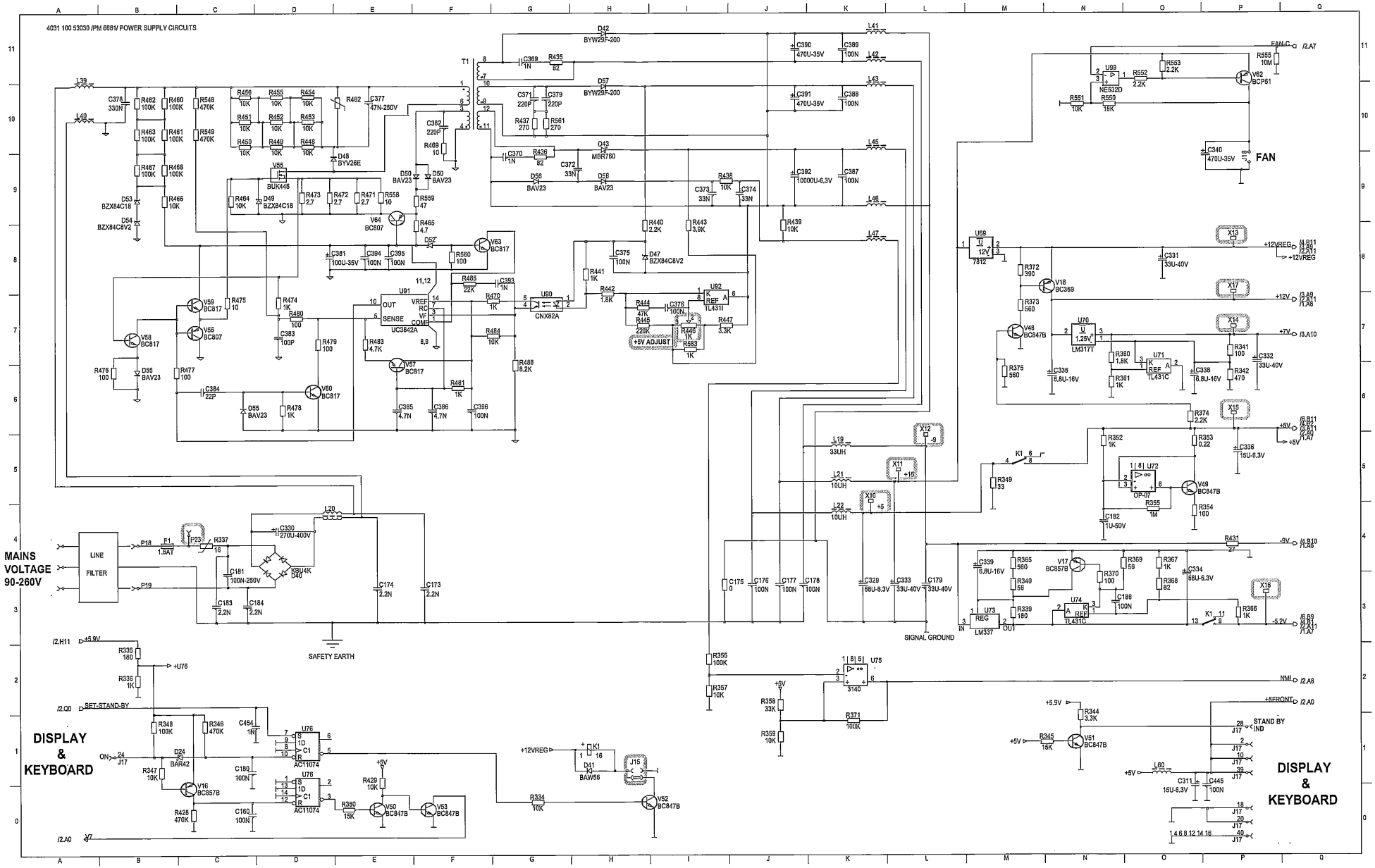


Trigger level DAC, Unit 1 sheet 4(6)

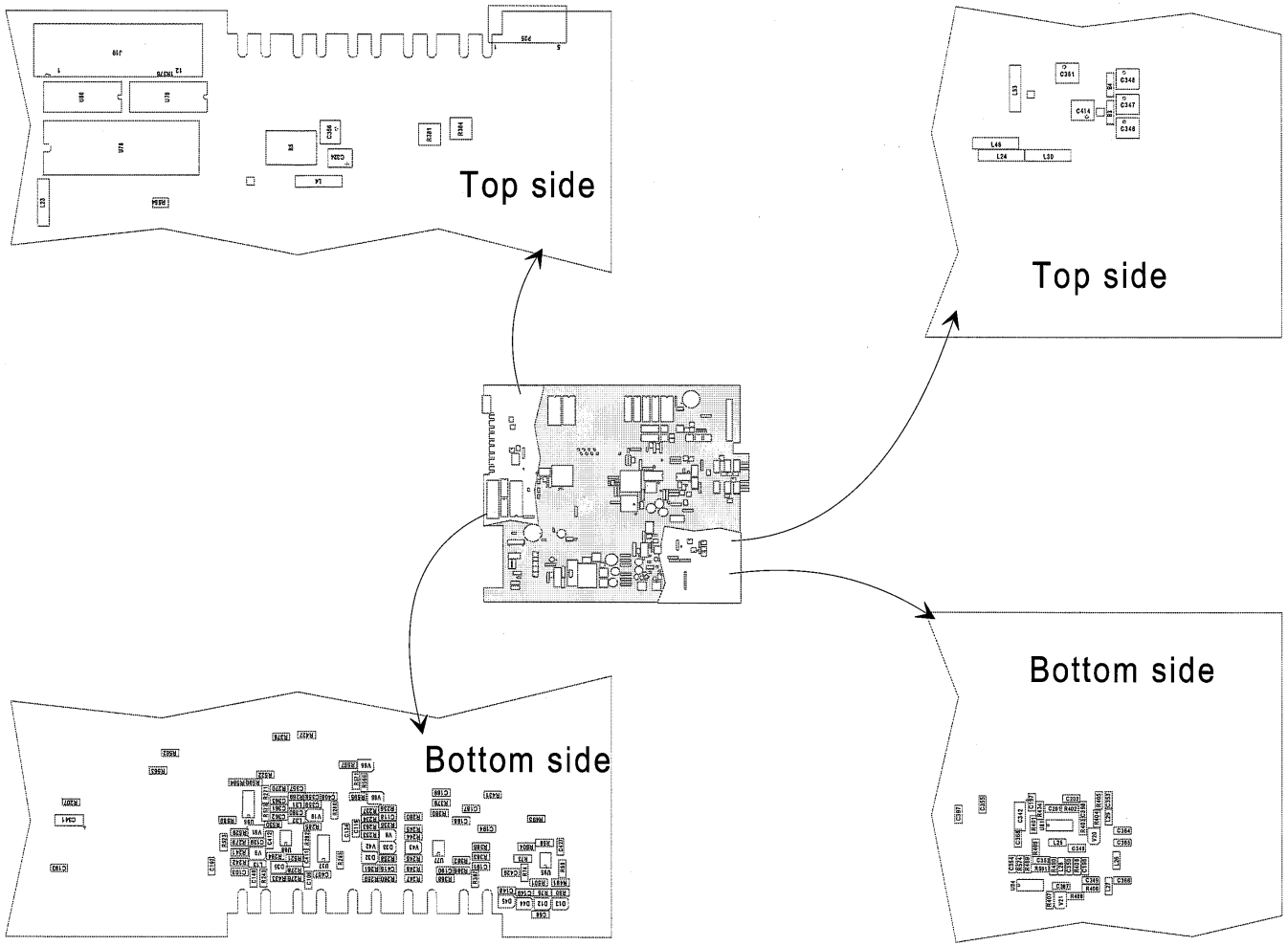


Basic board, Component layout

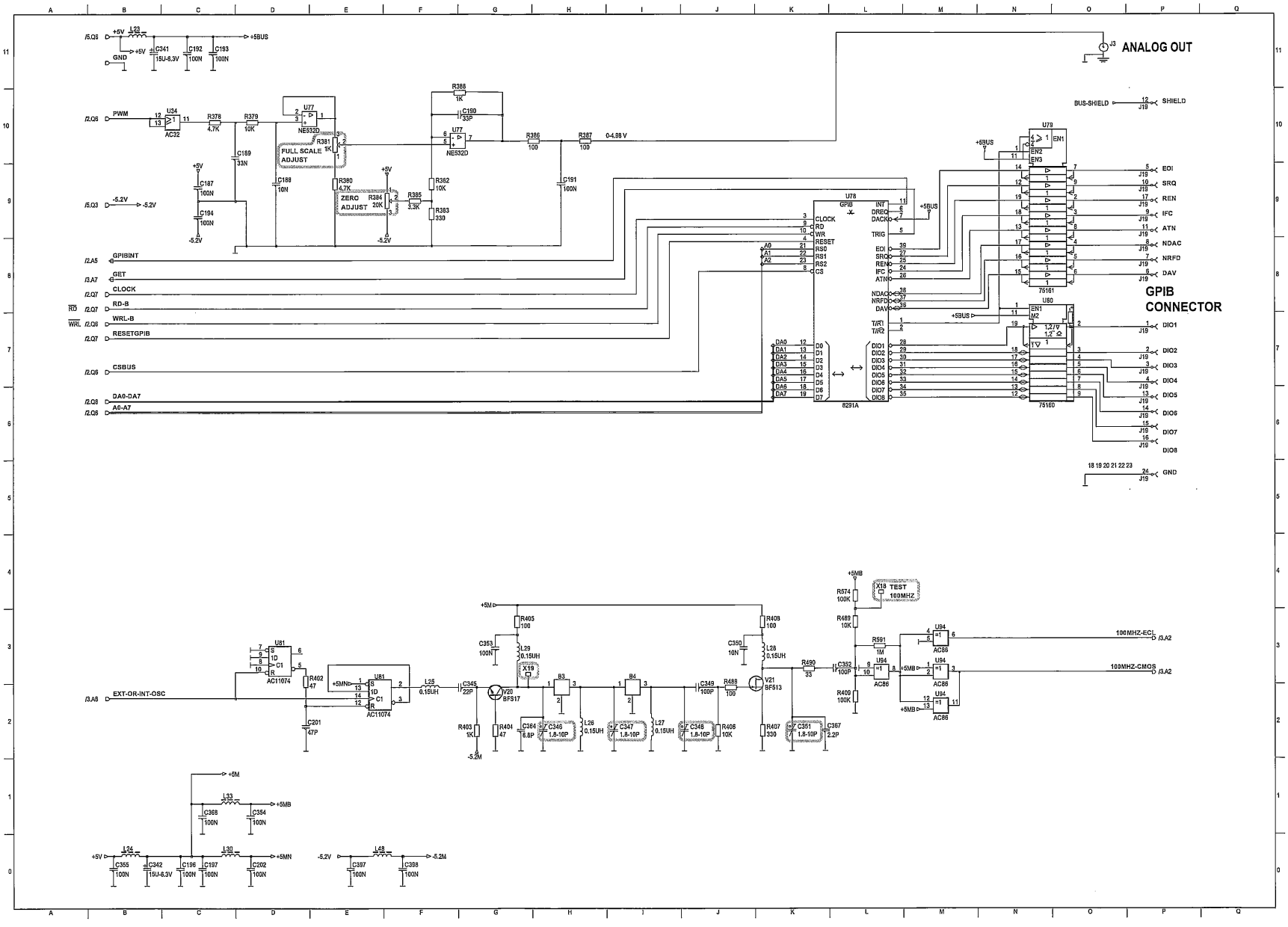



4031 100 53030 /PM 6681/ POWER SUPPLY CIRCUITS
MAINS VOLTAGE 90-260V
LINE FILTER
SAFETY EARTH
SIGNAL GROUND
DISPLAY & KEYBOARD
FAN
UC3842A
CNX82A
TL431I
TL431C
LM317T
LM337
NE532D
OP-07
AC11074
BAW56
BYW29F-200
MBR760
BAV23
BZX84C18
BZX84C8V2
BUK448
BCP51
BC369
BC847B
BC857B
BC817
BC807
BAR42
+12VREG
+5V
-5.2V
-9V
+7V
+12V
NMI
+5FRONT
STAND BY IND
SET-STAND-BY
ON

Basic board, Component layout

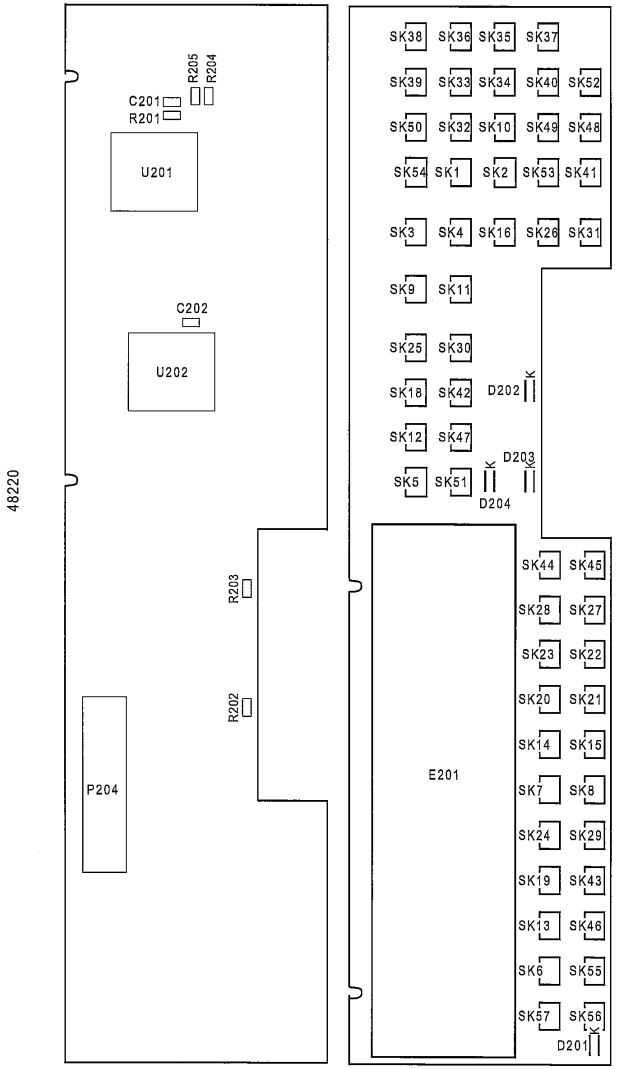


GPIB interface & Analog out, Unit 1 sheet 6(6)

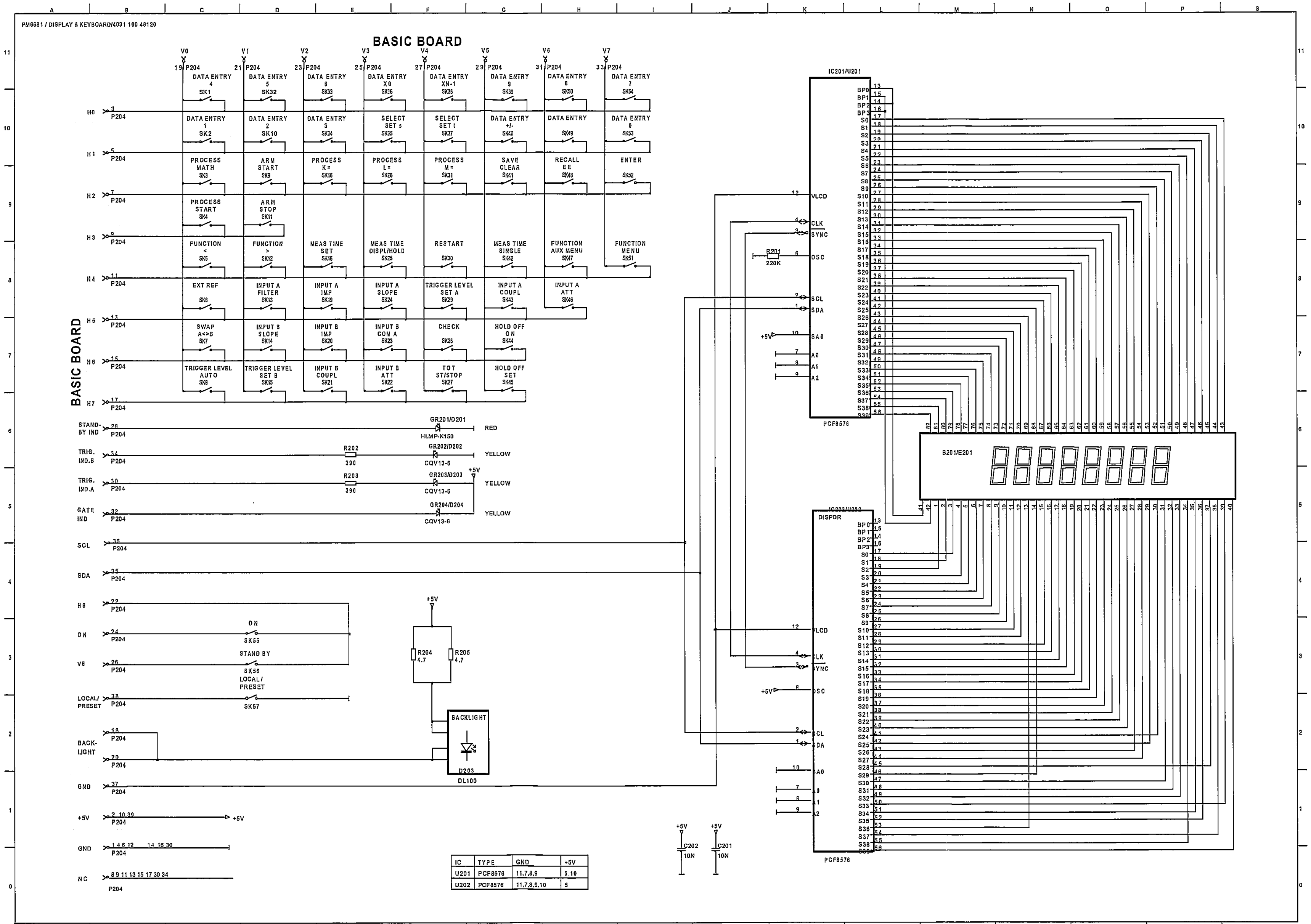


Display & Keyboard board, Component layout

Display and keyboard board			
IC	Type	GND	+5
U201	PCF8576	7, 8, 9, 11	5, 10
U202	PCF8576	7, 8, 9, 10, 11	5

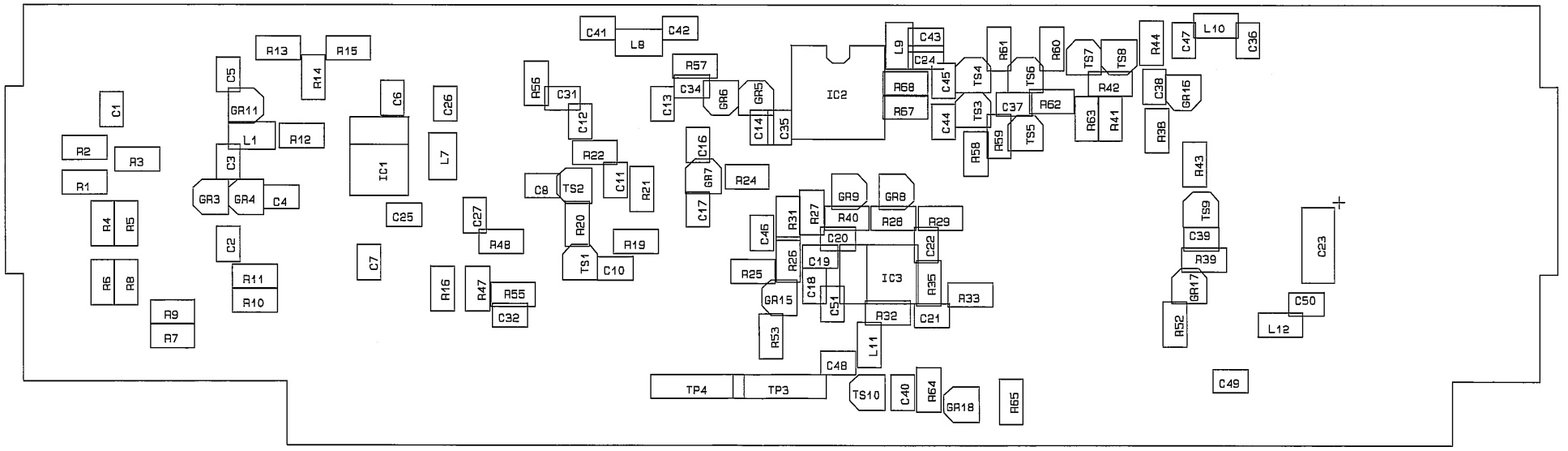


Display & Keyboard board, Unit 2

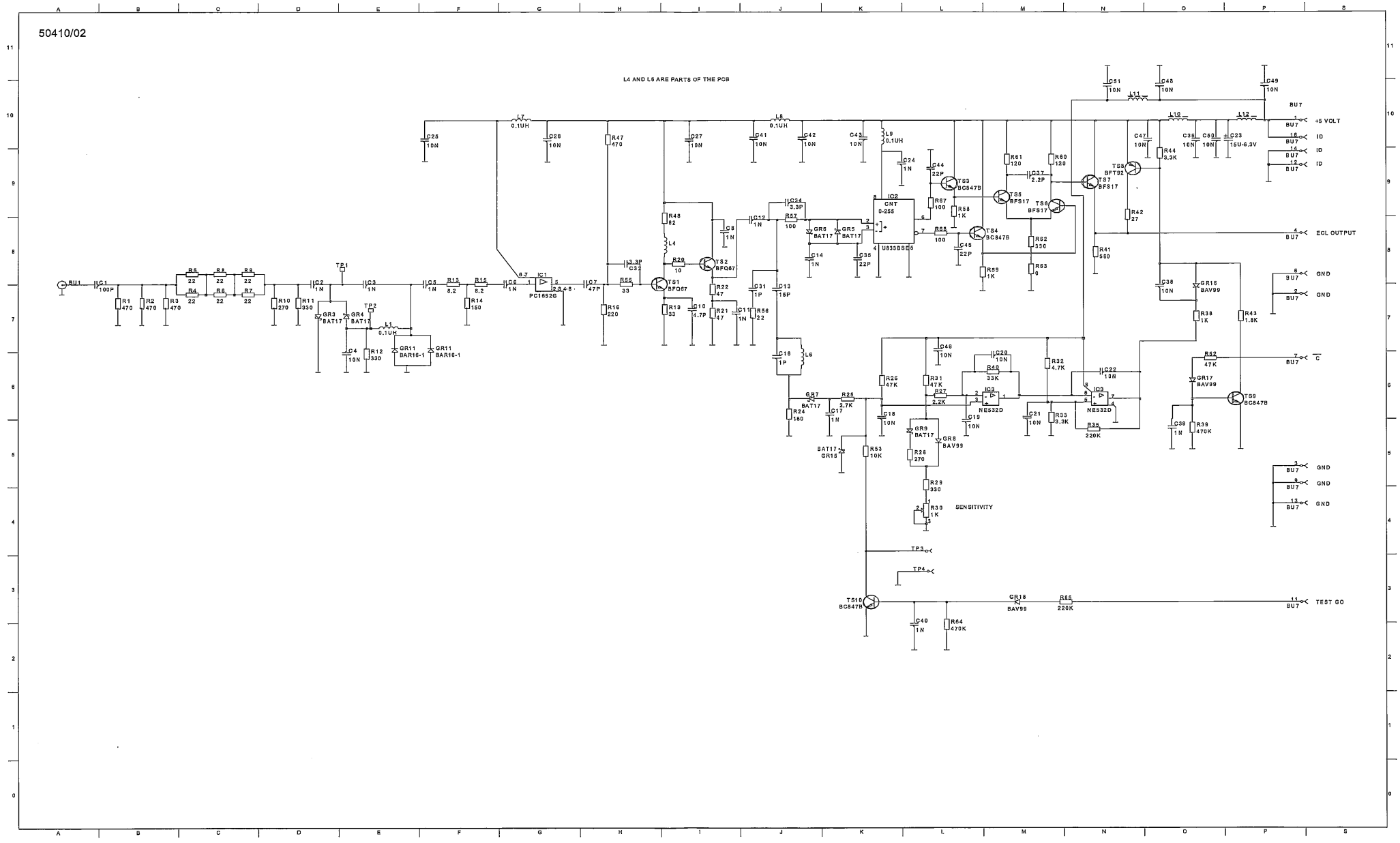


1.3 GHz HF-input, PM 9621, Component layout

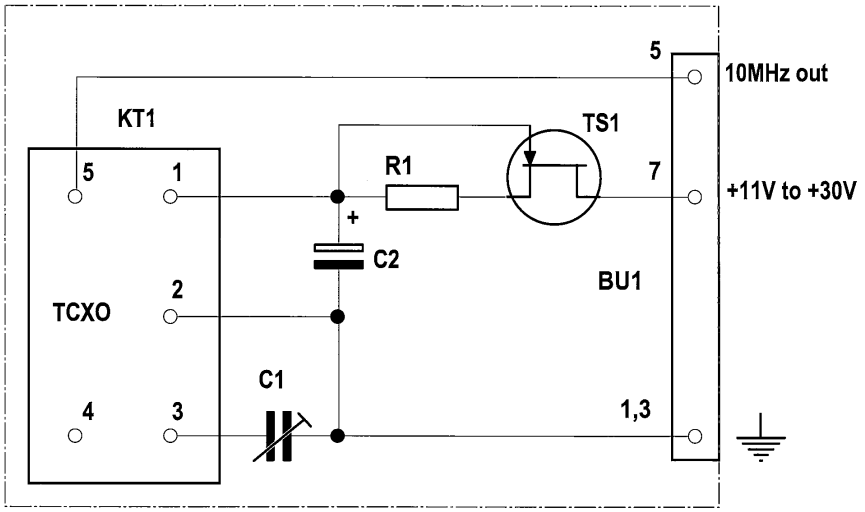
1.3 GHz HF-input			
IC	Type	GND	+5
IC1	PC1652G	2, 3, 4, 8	6, 7
IC2	U833BS	4, 5	6
IC3	NE532D	4, 8	

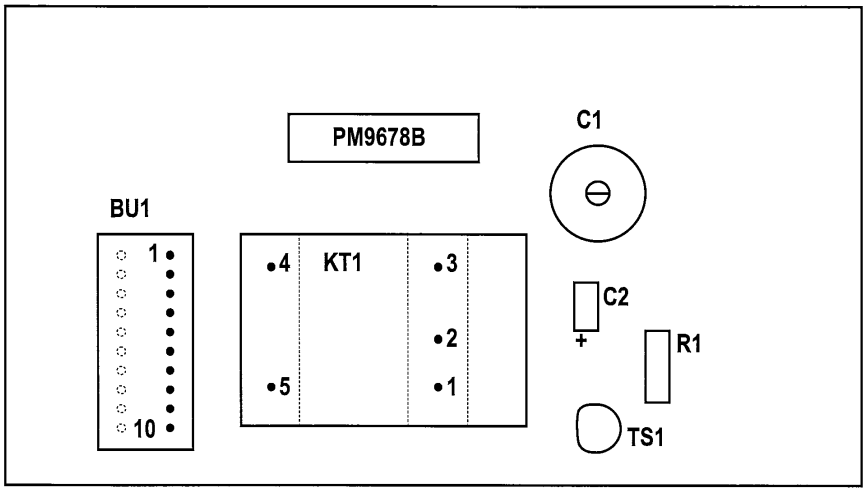


50400/02


50410/02
L4 AND L6 ARE PARTS OF THE PCB
SENSITIVITY
+5 VOLT
ID
ID
ID
ECL OUTPUT
GND
GND
C
GND
GND
GND
TEST GO
PC1652G
U833BSE5
CNT
0-255
NE532D
NE532D
BFT92
BFS17
BFS17
BFS17
BC847B
BC847B
BC847B
BC847B
BFQ67
BFQ67
BAT17
BAT17
BAT17
BAT17
BAT17
BAT17
BAR16-1
BAR16-1
BAV99
BAV99
BAV99
BAV99
BU1
BU7

TCXO, PM 9678B





Chapter 9

Appendix

How to Replace Surface Mounted Devices

Most of the components in this instrument are mounted on the surface of the board instead of through holes in the board. These components are not hard to replace but they require another technique. If you do not have special SMD desoldering equipment, follow the instructions below:

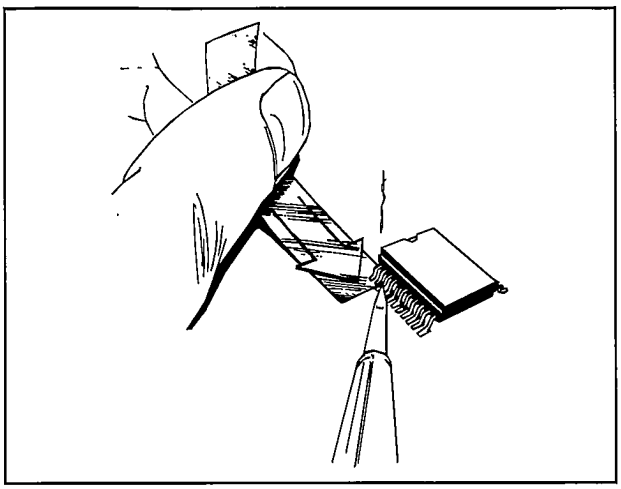


Figure 9-1 *Heat the leads and push a thin aluminum sheet between the leads and the pca.*

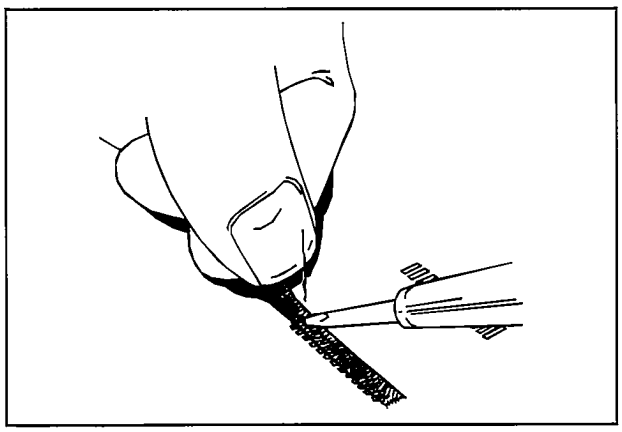


Figure 9-2 *When removed, clean the pads with desoldering braid.*

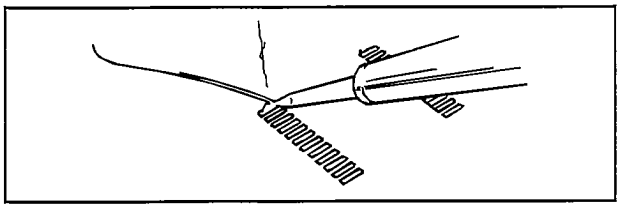


Figure 9-3 *Place solder on the pad.*

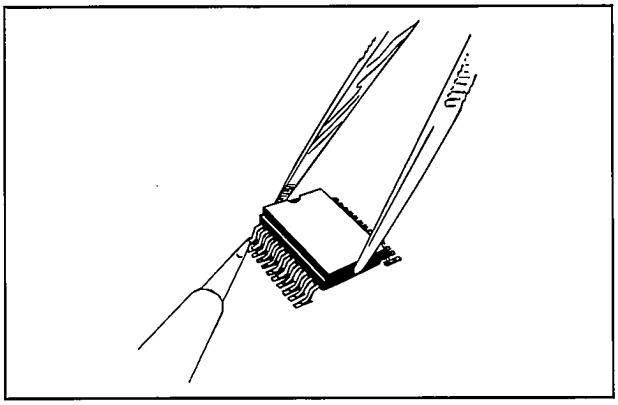


Figure 9-4 *Attach the IC to the pad with solder.*

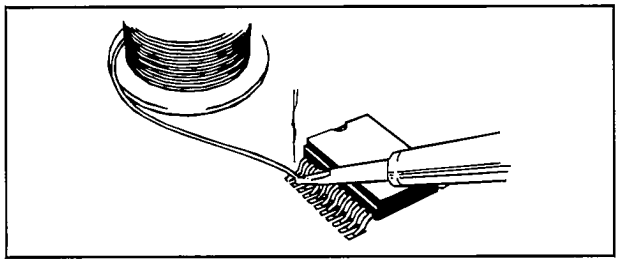


Figure 9-5 *Solder all leads with plenty of solder, don't worry about short-circuits at this stage.*

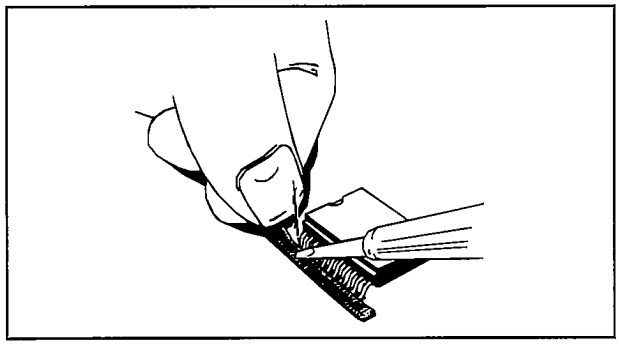


Figure 9-6 *Remove excessive solder with desoldering braid..*

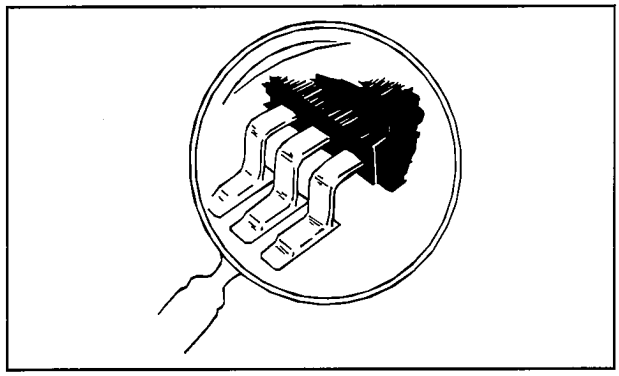
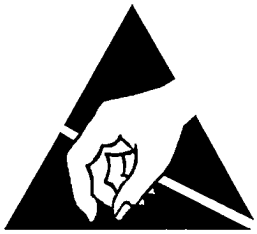


Figure 9-7 *Use a strong magnifying glas to make sure there are no short/circuits or unsoldered leads.*

Electrostatic discharge



Almost all modern components have extremely thin conductors and metal oxide layers. If these layers are exposed to electrostatic discharge they will break down or perhaps even worse, be damaged in a way that inevitably will cause a breakdown later on. The Electro-Static Discharge sensitivity of MOS and CMOS semiconductors have been known quite a while, but nowadays bipolar semiconductors and even precision resistors are ESD sensitive. Consider therefore all components, pc-boards and sub-assemblies as sensitive to electrostatic discharge. The text below explains how you can minimize the risk of damage or destroying these devices by being aware of the problems, and learning how to handle these components.

ESD sensitive options are packed in conductive containers marked with this symbol.

- *Never open the container unless you are at an ESD protected work station.*
- *Use a wrist strap grounded via a high resistance.*
- *Use a grounded work mat on your workbench.*
- *Never let your clothes come in contact with ESD sensitive equipment even when you are wearing a grounded wrist strap.*
- *Never touch the component leads.*
- *Never touch open connectors.*
- *Use ESD-safe packing materials.*
- *Use the packing material only once.*
- *Keep paper and nonconductive plastics etc. away from your workbench. These may block the discharge path to ground.*

Glossary

A	
ASIC	Application Specific Integrated Circuit
C	
Calibration Adjustments	How to restore an instrument to perform in agreement with its specifications
CSA	Canadian Safety Association safety standard.
G	
GaAs	A technique to make very fast ICs using Gallium Arsenide substrat.
GPIB	General Purpose Instrumentation Bus used for interconnecting several measuring instruments to a common controller.
I	
I^2C-bus	An internal address- and data bus for communication between microcontroller, measuring logic, and options.
IEC 1010-1	International Electrical Commission safety standard.
L	
LSI	Large Scale Intergarated circuit
O	
OCXO	Oven Controlled X-tal Oscillator
P	
PCA	Printed Circuit Assembly
Performance Check	A procedure to check that the instrument is functionally operational and performs to its specification. Must not require opening of cabinet. If the instrument passes the check it is considered as calibrated.
PWM	Pulse Width Modulated
U	
UCXO	Un-Compensated X-tal Oscillator (standard)

Unit 1

The main printed-circuit board (Unit 1) has recently been redesigned due to obsolescence of a number of integrated circuits. Designations found in circuit descriptions, schematic diagrams and parts lists in the first eight chapters refer to the original design. The functional descriptions are correct on the whole, if you make a few substitutions. A new set of schematic diagrams and a new replacement parts list are included in this chapter.

- Instruments having serial numbers >784919 belong to the new generation.
- The model PM6681R/676/AF has only been produced with the new Unit 1 board, so the serial number is irrelevant in this case.

Replacement Parts

Pos	Description	Part Number	☆
1	CIRCUIT DIAGRAM PM6681 BAS81	4031 100 53030	
2	PC-BOARD PM6681:1 BAS81	4031 100 53050	
8	NUT M6M 03 ST FZB	4822 505 10758	P
9	SCREW MRT 3X10 ST FZB TX	5322 502 21644	P
11	LOCK WASHER AZ3.2 ST FZ DIN6798A	4822 530 80082	P
12	SPRING WASHER KBA 3.2 ST FZ DIN137	4822 530 80173	P
13	WASHER BRB 3.2x8x1 ST FZ	4031 105 00120	
15	LABEL STATUS 25.4X12.7 POLYIMIDE	5322 454 13144	P
28	TAPE-DOUBLE COATED 6.4mm 4032	1222 100 20001	
39	SHIELD PM6681	5322 459 11185	P
40	SHIELD COVER PM6681	5322 447 92204	P
54	SCREW MRT 3X06 ST FZB TX	4822 502 11658	P
61	CONNECTOR-COAX BNC	5322 267 10004	S
64	SOLDERING LUG 10.0X15/21 CU SN	4031 100 58390	
66	TOROID CORE 30nH RCC9/6/3 4C65 VIOLET	5322 526 10545	P
70	BNC HOLDER PM6680,81,85	4031 100 48830	
102	WASHER 9.5X13X2.3 PM6680,81,85	4822 532 10222	P
205	CABLE WZT2801 Green	731 159 00002	
206	CABLE WZT 2801 Grey	731 159 00003	
207	STRAP SST-1M NATURELL L=102mm b=2.4	2422 015 05037	
208	FXF TUBE 3B 4.3x2 L=7.2	4822 526 10097	S
B1	CRYSTAL 16MHz PM5781 HC-49/U	5322 242 73307	S
B2	CRYSTAL 10MHz HC-49U/13	5322 242 82118	R
B3	CRYSTALFILTER 100MHz MF UB	5322 242 81692	S
B4	CRYSTALFILTER 100MHz MF UB	5322 242 81692	S
B5	CRYSTAL 10MHz HC-49U	5322 242 81694	R
C1	CAPACITOR 2.00pF 0.5-2pF 300V	5322 124 80335	S
C10	CAPACITOR 1nF 5% 63V NP0 1206	4822 122 31746	S
C100	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C101	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C102	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C103	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C104	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C106	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C107	CAPACITOR 82pF 5% 63V NP0 1206	4822 122 31839	S
C108	CAPACITOR 82pF 5% 63V NP0 1206	4822 122 31839	S
C109	CAPACITOR 22pF 5% 63V NP0 1206	4822 122 32482	
C11	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C110	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C111	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C112	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C113	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C114	CAPACITOR 10.0pF 1.8-10PF 300V	5322 125 50049	S
C115	CAPACITOR 15.0pF 2% 100V NP0 2M	4822 122 31823	S
C116	CAPACITOR 15.0pF 2% 100V NP0 2M	4822 122 31823	S
C117	CAPACITOR 1nF 5% 63V NP0 1206	4822 122 31746	S
C118	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C119	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C12	CAPACITOR 1nF 5% 63V NP0 1206	4822 122 31746	S
C120	CAPACITOR 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	S
C121	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C122	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C125	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C126	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C127	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C128	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C129	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C13	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C130	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C131	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C132	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C133	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C134	CAPACITOR 10pF 5% 63V NP0 1206	4822 122 31971	S
C135	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C136	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C137	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C138	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C139	CAPACITOR 220pF 5% 63V NP0 1206	4822 122 31965	S
C14	CAPACITOR 22nF 10% 200V X7R 1206	5322 126 14081	R
C140	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C143	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C144	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C145	CAPACITOR 12.0pF 2% 100V NP0 2M	4822 122 31056	S
C146	CAPACITOR 15pF 5% 63V NP0 1206	4822 122 32504	S
C147	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C148	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C149	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C150	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C151	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C152	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C153	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C154	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C156	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C157	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S

Pos	Description	Part Number	☆
C16	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C160	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C165	CAPACITOR 33pF 5% 63V NP0 1206	4822 126 10324	S
C166	CAPACITOR 33pF 5% 63V NP0 1206	4822 126 10324	S
C167	CAPACITOR 1uF 10% 50V MMKO-5 PETP	5322 121 42515	S
C168	CAPACITOR 1uF 10% 50V MMKO-5 PETP	5322 121 42515	S
C169	CAPACITOR 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	S
C17	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C170	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C171	CAPACITOR 33pF 5% 63V NP0 1206	4822 126 10324	S
C172	CAPACITOR 33pF 5% 63V NP0 1206	4822 126 10324	S
C173	CAPACITOR 2.20nF PME289MA4220MR04	5322 121 43756	S
C174	CAPACITOR 2.20nF PME289MA4220MR04	5322 121 43756	S
C175	RESISTOR 0 ohm BYGLING RC-01 1206	4822 051 10008	S
C176	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C177	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C178	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C179	CAPACITOR 100µF 20% 35V 2M 8.2x11	5322 124 40852	S
C18	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C180	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C181	CAPACITOR 100nF 20% 250V	2222 336 20104	
C182	CAPACITOR 1uF 10% 50V MMKO-5 PETP	5322 121 42515	S
C183	CAPACITOR 2.20nF PME289MA4220MR04	5322 121 43756	S
C184	CAPACITOR 2.20nF PME289MA4220MR04	5322 121 43756	S
C186	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C187	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C188	CAPACITOR 10.0nF 10% 63V X7R 1206	4822 122 32442	S
C189	CAPACITOR 33.0nF 10% 50V X7R 1206	4822 122 31981	S
C190	CAPACITOR 33pF 5% 63V NP0 1206	4822 126 10324	S
C191	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C192	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C193	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C194	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C196	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C197	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C2	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C20	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C201	CAPACITOR 47pF 5% 63V NP0 1206	4822 122 31772	S
C202	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C21	CAPACITOR 1nF 5% 63V NP0 1206	4822 122 31746	S
C22	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C24	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C25	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C26	CAPACITOR 1nF 5% 63V NP0 1206	4822 122 31746	S
C29	CAPACITOR 10.0nF 10% 63V X7R 1206	4822 122 32442	S
C3	CAPACITOR 1nF 5% 63V NP0 1206	4822 122 31746	S
C30	CAPACITOR 10.0nF 10% 63V X7R 1206	4822 122 32442	S
C302	CAPACITOR 2200µF 20% 16V RAD 2M 12.5X25	4822 124 40723	S
C303	CAPACITOR 68µF 20% 6.3V SOLID AL	5322 124 10455	S
C304	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C305	CAPACITOR 68µF 20% 6.3V SOLID AL	5322 124 10455	S
C306	CAPACITOR 2200µF 20% 16V RAD 2M 12.5X25	4822 124 40723	S
C307	CAPACITOR 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	S
C308	CAPACITOR 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	S
C31	CAPACITOR 10.0nF 10% 63V X7R 1206	4822 122 32442	S
C310	CAPACITOR 2.20 µF 20%6.3V 3.2X1.6 MOLD	5322 124 10685	S
C311	CAPACITOR 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	S
C313	CAPACITOR 6.80 µF 20% 16V 6.0X3.2 MOLD	5322 124 10687	R
C314	CAPACITOR 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	S
C315	CAPACITOR 6.80 µF 20% 16V 6.0X3.2 MOLD	5322 124 10687	R
C316	CAPACITOR 6.80 µF 20% 16V 6.0X3.2 MOLD	5322 124 10687	R
C317	CAPACITOR 33µF 20% 10V SOLID AL	5322 124 11084	S
C318	CAPACITOR 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	S
C319	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C32	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C320	CAPACITOR 68µF 20% 6.3V SOLID AL	5322 124 10455	S
C321	CAPACITOR 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	S
C323	CAPACITOR 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	S
C324	CAPACITOR 68µF 20% 6.3V SOLID AL	5322 124 10455	S
C325	CAPACITOR 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	S
C326	CAPACITOR 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	S
C327	CAPACITOR 68µF 20% 6.3V SOLID AL	5322 124 10455	S
C328	CAPACITOR 68µF 20% 6.3V SOLID AL	5322 124 10455	S
C329	CAPACITOR 68µF 20% 6.3V SOLID AL	5322 124 10455	S
C33	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C330	CAPACITOR 270µF 20% SMG 400V 25X45	5322 124 80334	S
C331	CAPACITOR 100µF 20% 35V 2M 8.2x11	5322 124 40852	S
C332	CAPACITOR 100µF 20% 35V 2M 8.2x11	5322 124 40852	S
C333	CAPACITOR 100µF 20% 35V 2M 8.2x11	5322 124 40852	S
C334	CAPACITOR 68µF 20% 6.3V SOLID AL	5322 124 10455	S
C335	CAPACITOR 6.80 µF 20% 16V 6.0X3.2 MOLD	5322 124 10687	R
C336	CAPACITOR 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	S
C338	CAPACITOR 6.80 µF 20% 16V 6.0X3.2 MOLD	5322 124 10687	R
C339	CAPACITOR 6.80 µF 20% 16V 6.0X3.2 MOLD	5322 124 10687	R
C34	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C340	CAPACITOR 470µF 20% 35V 2M 12.5x20	5322 126 13131	S
C341	CAPACITOR 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	S
C342	CAPACITOR 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	S
C344	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C345	CAPACITOR 22pF 5% 63V NP0 1206	4822 122 32482	
C346	CAPACITOR 3.5pF 1.2-3.5pF 300V 2M 6x8x9	2222 809 05215	
C347	CAPACITOR 10.0pF 1.8-10PF 300V	5322 125 50049	S
C348	CAPACITOR 3.5pF 1.2-3.5pF 300V 2M 6x8x9	2222 809 05215	
C35	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C350	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C351	CAPACITOR 10.0pF 1.8-10PF 300V	5322 125 50049	S
C352	CAPACITOR 100pF 5% 50V NP0 0805 B	2222 861 15101	
C353	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C354	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C355	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C356	CAPACITOR 18.0pF 2.0-18PF 300V	2222 809 05217	
C357	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S

Pos	Description	Part Number	☆
C358	CAPACITOR 33pF 5% 63V NP0 1206	4822 126 10324	S
C359	CAPACITOR 15pF 5% 63V NP0 1206	4822 122 32504	S
C36	CAPACITOR 2200µF 20% 16V RAD 2M 12.5X25	4822 124 40723	S
C360	CAPACITOR 2.2pF±0.25pF 63V NP0 1206	4822 863 15228	S
C361	CAPACITOR 33pF 5% 63V NP0 1206	4822 126 10324	S
C362	CAPACITOR 15pF 5% 63V NP0 1206	4822 122 32504	S
C363	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C364	CAPACITOR 8.2pF ±0.25pF 50V N750 1206SMD	2020 552 95905	
C365	CAPACITOR 8.2pF ±0.25pF 50V N750 1206SMD	2020 552 95905	
C366	CAPACITOR 5.6pF ±0.25pF 50V N750 1206SMD	2020 552 95871	
C367	CAPACITOR 8.2pF ±0.25pF 50V N750 1206SMD	2020 552 95905	
C368	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C369	CAPACITOR 1nF 5% 63V NP0 1206	4822 122 31746	S
C37	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C370	CAPACITOR 1nF 5% 63V NP0 1206	4822 122 31746	S
C371	CAPACITOR 220pF 5% 63V NP0 1206	4822 122 31965	S
C372	CAPACITOR 33.0nF 10% 50V X7R 1206	4822 122 31981	S
C373	CAPACITOR 33.0nF 10% 50V X7R 1206	4822 122 31981	S
C374	CAPACITOR 33.0nF 10% 50V X7R 1206	4822 122 31981	S
C375	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C376	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C377	CAPACITOR 47nF 10% 250V POLYCARB	4822 121 41676	S
C378	CAPACITOR 330nF 20% 250V	2222 336 20334	
C379	CAPACITOR 220pF 5% 63V NP0 1206	4822 122 31965	S
C38	CAPACITOR 18.0pF 2.0-18PF 300V	2222 809 05217	
C381	CAPACITOR 100µF 20% 35V 2M 8.2x11	5322 124 40852	S
C382	CAPACITOR 220pF 5% 63V NP0 1206	4822 122 31965	S
C383	CAPACITOR 100pF 5% 63V NP0 1206	4822 122 31765	S
C384	CAPACITOR 22pF 5% 63V NP0 1206	4822 122 32482	
C385	CAPACITOR 4.70nF 10% 63V X7R 1206	4822 122 31784	S
C386	CAPACITOR 4.70nF 10% 63V X7R 1206	4822 122 31784	S
C387	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C388	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C389	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C39	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C390	CAPACITOR 470µF 20% 35V 2M 12.5x20	5322 126 13131	S
C391	CAPACITOR 470µF 20% 35V 2M 12.5x20	5322 126 13131	S
C392	CAPACITOR 10000µF 20% 6.3V 3M 18x35	5322 124 80821	
C393	CAPACITOR 1nF 5% 63V NP0 1206	4822 122 31746	S
C394	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C395	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C396	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C397	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C398	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C4	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C40	CAPACITOR 18.0pF 2.0-18PF 300V	2222 809 05217	
C403	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C404	CAPACITOR 12pF 5% 63V NP0 1206	4822 122 32139	S
C405	CAPACITOR 12pF 5% 63V NP0 1206	4822 122 32139	S
C406	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C407	CAPACITOR 100pF 5% 63V NP0 1206	4822 122 31765	S
C408	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C409	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C41	CAPACITOR 10.0nF 10% 63V X7R 1206	4822 122 32442	S
C410	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C411	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C412	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C415	CAPACITOR 5.6pF ±0.5pF 63V NP0 1206	4822 122 32506	S
C416	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C417	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C418	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C419	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C42	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C420	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C421	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C426	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C427	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C428	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C429	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C430	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C432	CAPACITOR 18.0pF 2.0-18PF 300V	2222 809 05217	
C436	CAPACITOR 18.0pF 2.0-18PF 300V	2222 809 05217	
C44	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C441	CAPACITOR 12pF 5% 63V NP0 1206	4822 122 32139	S
C442	CAPACITOR 12pF 5% 63V NP0 1206	4822 122 32139	S
C445	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C447	CAPACITOR 33pF 5% 63V NP0 1206	4822 126 10324	S
C448	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C449	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C450	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C451	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C452	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C453	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C454	CAPACITOR 1nF 5% 63V NP0 1206	4822 122 31746	S
C455	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C456	CAPACITOR 68µF 20% 6.3V SOLID AL	5322 124 10455	S
C457	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C46	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C49	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C5	CAPACITOR 22nF 10% 200V X7R 1206	5322 126 14081	R
C50	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C51	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C52	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C55	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C57	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C58	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C59	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C60	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C61	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C62	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C63	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C64	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C65	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C66	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S

Pos	Description	Part Number	☆
C68	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C69	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C7	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C71	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C75	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C76	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C77	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C78	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C79	CAPACITOR 1nF 5% 63V NP0 1206	4822 122 31746	S
C8	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C80	CAPACITOR 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	S
C82	CAPACITOR 68µF 20% 6.3V SOLID AL	5322 124 10455	S
C87	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C88	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C89	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C9	CAPACITOR 2.00pF 0.5-2pF 300V	5322 124 80335	S
C90	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C91	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C92	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C93	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C94	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C95	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C96	CAPACITOR 100nF 10% 63V X7R 1206	4822 122 33496	S
C97	CAPACITOR 18pF 5% 63V NP0 1206	2222 863 15189	
C98	CAPACITOR 47pF 5% 63V NP0 1206	4822 122 31772	S
C99	CAPACITOR 18pF 5% 63V NP0 1206	2222 863 15189	
D10	DIODE 0.10A BAT18 35V 1PF SOT23	5322 130 32076	S
D11	DIODE 0.10A BAT18 35V 1PF SOT23	5322 130 32076	S
D12	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D13	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D18	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D23	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D24	DIODE 0.10A BAR42 30V SOT23	5322 130 83586	S
D26	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D27	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D30	DIODE 0.15A BAS45 125V DO-35	5322 130 32256	S
D31	DIODE 0.10A BAR42 30V SOT23	5322 130 83586	S
D32	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D33	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D35	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D38	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D4	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D40	BRIDGE RECTIF 4A KBU4K 800V	4822 130 80497	S
D41	DIODE 0.25A BAW56 70V SOT23	5322 130 30691	S
D42	DIODE 7A BYW29/200 TO-220AC	5322 130 32328	S
D43	DIODE 7.5A MBR760 60V TO220	5322 130 83602	S
D43	HEAT SINK 16øK/W LÖDBAR TO217	5322 255 41313	P
D44	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D45	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D47	DIODE 0.35 W BZX84-C8V2 SOT23	5322 130 80255	S
D48	DIODE BYV26E DOD57	4822 130 60815	S
D49	DIODE 0.35 W BZX84-C18 SOT23	5322 130 80212	S
D5	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D50	DIODE 0.2A BAV23 200V SOT143	5322 130 33764	S
D52	DIODE 0.35 W BZX84-C18 SOT23	5322 130 80212	S
D53	DIODE 0.35 W BZX84-C18 SOT23	5322 130 80212	S
D54	DIODE 0.35 W BZX84-C8V2 SOT23	5322 130 80255	S
D55	DIODE 0.2A BAV23 200V SOT143	5322 130 33764	S
D56	DIODE 0.2A BAV23 200V SOT143	5322 130 33764	S
D57	DIODE 7A BYW29/200 TO-220AC	5322 130 32328	S
D57	HEAT SINK 16øK/W LÖDBAR TO218	5322 255 41313	P
D58	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D59	DIODE 0.10A BAR42 30V SOT23	5322 130 83586	S
D6	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D60	DIODE 0.35W BZX84-B5V6 2% SOT23	4822 130 33004	S
D61	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D62	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D64	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D66	DIODE 0.2A BAV23 200V SOT143	5322 130 33764	S
D7	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D8	DIODE 0.10A BAT18 35V 1PF SOT23	5322 130 32076	S
D9	DIODE 0.10A BAT18 35V 1PF SOT23	5322 130 32076	S
F1	FUSE HOLDER 011 656 5X20mm	4822 256 30139	S
G1	BATTERY HOLDER 20mm BH800 KNAPPCELL	5322 256 60311	S
GND	CONNECTOR 3 POL F095 SINGLE ROW	5322 290 60445	S
5			
GND	CONNECTOR 3 POL F095 SINGLE ROW	5322 290 60445	S
6			
GND	CONNECTOR 3 POL F095 SINGLE ROW	5322 290 60445	S
7			
J12	CONNECTOR 2POL F095 JUMPER GREY	5322 263 50101	S
J12	CONNECTOR 3 POL F095 SINGLE ROW	5322 290 60445	S
J15	CONNECTOR 2POL F095 JUMPER GREY	5322 263 50101	S
J15	CONNECTOR 3 POL F095 SINGLE ROW	5322 290 60445	S
J17	CABLE ASSY PM6681	5322 321 62336	P
J18	CONNECTOR 2 POL F095 SINGLE ROW	5322 265 44074	S
J19	CONNECTOR 24 POL 57LE-20240-77OOD35G	5322 267 60148	S
J22	CONNECTOR 2 POL F095 SINGLE ROW	5322 265 44074	S
J23	CONNECTOR 2 POL F095 SINGLE ROW	5322 265 44074	S
K1	RELAY 2p vx V23042-A1003-B101 (alt.A2303)	5322 280 60557	R
K2	RELAY TQ2-5 SV/1A 2pol vx 14X9X5m	5322 280 20514	R
K3	RELAY TQ2-5 SV/1A 2pol vx 14X9X5m	5322 280 20514	R
K4	RELAY TQ2-5 SV/1A 2pol vx 14X9X5m	5322 280 20514	R
K5	RELAY TQ2-5 SV/1A 2pol vx 14X9X5m	5322 280 20514	R
K6	RELAY TQ2-5 SV/1A 2pol vx 14X9X5m	5322 280 20514	R
K7	RELAY TQ2-5 SV/1A 2pol vx 14X9X5m	5322 280 20514	R
K8	RELAY TQ2-5 SV/1A 2pol vx 14X9X5m	5322 280 20514	R
K9	RELAY TQ2-5 SV/1A 2pol vx 14X9X5m	5322 280 20514	R
L1	CHOKE 220 µH 10% NL453232T-221K	5322 157 61918	S
L10	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L11	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L12	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L13	CHOKE 1µH 20% B82412-A1102-M	2412 541 00458	
L14	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L15	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L16	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L17	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L18	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L19	CHOKE 33µH TSL0809-330K1R2	5322 157 53568	S
L20	CHOKE 10mH B82722-J2102-N1 1A	5322 157 70143	S
L21	CHOKE 10.00µH NEWPORT 18R103	2422 536 00061	
L22	CHOKE 10.00µH NEWPORT 18R103	2422 536 00061	
L23	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L24	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L25	CHOKE 0.15µH 10% MLF3216DR15K	5322 157 71041	S
L26	CHOKE 0.15µH 10% MLF3216DR15K	5322 157 71041	S
L27	CHOKE 0.15µH 10% MLF3216DR15K	5322 157 71041	S
L28	CHOKE 0.10 µH 10% MLF3216DR10K	5322 157 52986	S
L29	CHOKE 0.15µH 10% MLF3216DR15K	5322 157 71041	S
L3	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L30	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L31	CHOKE 4.70µH 5% LQH1N4R7J	2422 535 94048	
L32	CHOKE 4.70µH 5% LQH1N4R7J	2422 535 94048	
L33	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L39	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L4	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L40	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L41	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L42	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L43	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L45	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L46	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L47	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L48	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L49	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L5	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L50	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L51	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L52	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L53	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L54	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L55	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L56	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L57	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L58	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L59	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L60	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L61	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L62	CHOKE 31 ohm CB50-321611T 1206	5322 157 61919	S
L7	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L8	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S

Pos	Description	Part Number	☆
L9	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
P18	FLAT PIN 2.8mm E184/8 LESA SN BAND	5322 290 34064	S
P19	FLAT PIN 2.8mm E184/8 LESA SN BAND	5322 290 34064	S
P20	CONNECTOR 16 POL TMH-108-01-L-DW	5322 265 41013	S
P21	CONNECTOR 10 POL 22-03-2101 4030-10A	5322 265 64028	S
P24	FLAT PIN 2.8mm E184/8 LESA SN BAND	5322 290 34064	S
P25	CONNECTOR 10 POL SINGLE ROW 90DEG	4031 105 70790	
P26	FLAT PIN 2.8mm E184/8 LESA SN BAND	5322 290 34064	S
P7	CONNECTOR 3 POL F095 SINGLE ROW	5322 290 60445	S
R10	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R100	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R101	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R102	RESISTOR 82 ohm 1% .125W 100PPM 1206	4822 051 10829	S
R103	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R104	RESISTOR 120 ohm 1% 0.125W 100PPM 1206	4822 051 10121	S
R105	RESISTOR 120 ohm 1% 0.125W 100PPM 1206	4822 051 10121	S
R108	RESISTOR 10 Mohm 10% 0.25W RC-01 1206	4822 051 10106	S
R109	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R11	RESISTOR 2.70kohm 1% .125W 100PPM 1206	4822 051 52702	S
R110	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R111	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R112	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R113	RESISTOR 10 Mohm 10% 0.25W RC-01 1206	4822 051 10106	S
R116	RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206	4822 051 10109	S
R118	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R12	RESISTOR 1.80kohm 1% .125W 100PPM 1206	4822 051 10182	S
R124	RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206	4822 051 10109	S
R125	RESISTOR 12.0kohm 1% .125W 100PPM 1206	5322 117 10968	S
R126	RESISTOR 8.20kohm 1% .125W 100PPM 1206	4822 051 10822	S
R127	RESISTOR 220.0ohm 1% .125W 100PPM 1206	4822 051 52201	S
R128	RESISTOR 680 ohm 1% .125W 100PPM 1206	4822 051 56801	S
R129	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R13	RESISTOR 220.0ohm 1% .125W 100PPM 1206	4822 051 52201	S
R131	RESISTOR 27.0 ohm 1% .125W 100PPM 1206	5322 116 82262	S
R132	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R133	RESISTOR 27.0 ohm 1% .125W 100PPM 1206	5322 116 82262	S
R134	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R135	RESISTOR 39 ohm 1% .125W 100PPM 1206	5322 116 82263	S
R136	RESISTOR 39 ohm 1% .125W 100PPM 1206	5322 116 82263	S
R137	RESISTOR 39 ohm 1% .125W 100PPM 1206	5322 116 82263	S
R138	RESISTOR 39 ohm 1% .125W 100PPM 1206	5322 116 82263	S
R139	RESISTOR 39 ohm 1% .125W 100PPM 1206	5322 116 82263	S
R14	RESISTOR 1.50kohm 1% 0.125W 100PPM 1206	4822 051 51502	S
R140	RESISTOR 39 ohm 1% .125W 100PPM 1206	5322 116 82263	S
R141	RESISTOR 39 ohm 1% .125W 100PPM 1206	5322 116 82263	S
R142	RESISTOR 39 ohm 1% .125W 100PPM 1206	5322 116 82263	S
R143	RESISTOR 39 ohm 1% .125W 100PPM 1206	5322 116 82263	S
R144	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R145	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R146	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R147	RESISTOR 39 ohm 1% .125W 100PPM 1206	5322 116 82263	S
R148	RESISTOR 39 ohm 1% .125W 100PPM 1206	5322 116 82263	S
R149	RESISTOR 39 ohm 1% .125W 100PPM 1206	5322 116 82263	S
R15	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R150	RESISTOR 39 ohm 1% .125W 100PPM 1206	5322 116 82263	S
R151	RESISTOR 39 ohm 1% .125W 100PPM 1206	5322 116 82263	S
R152	RESISTOR 39 ohm 1% .125W 100PPM 1206	5322 116 82263	S
R153	RESISTOR 39 ohm 1% .125W 100PPM 1206	5322 116 82263	S
R154	RESISTOR 39 ohm 1% .125W 100PPM 1206	5322 116 82263	S
R155	RESISTOR 39 ohm 1% .125W 100PPM 1206	5322 116 82263	S
R156	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R157	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R158	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R16	RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206	5322 117 10858	S
R161	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R162	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R163	RESISTOR 82 ohm 1% .125W 100PPM 1206	4822 051 10829	S
R164	RESISTOR 82 ohm 1% .125W 100PPM 1206	4822 051 10829	S
R165	RESISTOR 330 ohm 1% .125W 100PPM 1206	4822 051 53301	S
R166	RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206	4822 051 10109	S
R167	POTENTIOMETER 100kohm 20% 3362P-1-104	2122 362 01083	
R168	POTENTIOMETER 100kohm 20% 3362P-1-104	2122 362 01083	
R169	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R17	RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206	5322 117 10858	S
R170	RESISTOR 330 ohm 1% .125W 100PPM 1206	4822 051 53301	S
R171	RESISTOR 560 ohm 1% .125W 100PPM 1206	4822 051 10561	S
R172	RESISTOR 2.20kohm 1% .125W 100PPM 1206	4822 051 52202	S
R173	RESISTOR 2.20kohm 1% .125W 100PPM 1206	4822 051 52202	S
R174	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R175	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R176	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R177	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R178	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R179	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R18	POTENTIOMETER 20kohm 10% 3323P-1-203-10	5322 101 11074	S
R180	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R181	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R182	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R183	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R184	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R185	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R186	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R187	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R188	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R189	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R19	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R190	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R191	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R192	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R193	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R194	RESISTOR 39.0kohm 1% .125W 100PPM 1206	4822 051 53903	S
R195	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R196	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R197	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R198	RESISTOR 220.0ohm 1% .125W 100PPM 1206	4822 051 52201	S
R199	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R20	RESISTOR 390 ohm 1% .125W 100PPM 1206	4822 051 53901	S
R200	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R201	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R202	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R203	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R204	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R206	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R207	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R208	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R209	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R21	RESISTOR 390 ohm 1% .125W 100PPM 1206	4822 051 53901	S
R210	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R211	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R212	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R217	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R22	RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206	5322 117 10858	S
R220	RESISTOR 820 ohm 1% .125W 100PPM 1206	5322 116 82264	S
R221	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R222	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R223	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R224	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R225	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R226	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R227	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R228	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R229	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R23	RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206	5322 117 10858	S
R230	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R231	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R232	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R233	RESISTOR 270 ohm 1% .125W 100PPM 1206	4822 051 10271	S
R234	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R235	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R236	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R237	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R238	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R239	RESISTOR 1.00Mohm 1% 0.125W 100PPM 1206	4822 051 10105	S
R24	RESISTOR 15.0Kohm 1% .125W 100PPM 1206	5322 116 82261	S
R240	RESISTOR 560 ohm 1% .125W 100PPM 1206	4822 051 10561	S
R241	RESISTOR 1.50kohm 1% 0.125W 100PPM 1206	4822 051 51502	S
R242	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R243	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R244	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R245	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R246	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R247	RESISTOR 68 ohm 1% .125W 100PPM 1206	4822 051 10689	S
R248	RESISTOR 68 ohm 1% .125W 100PPM 1206	4822 051 10689	S
R249	RESISTOR 15.0Kohm 1% .125W 100PPM 1206	5322 116 82261	S
R25	RESISTOR 330 ohm 1% .125W 100PPM 1206	4822 051 53301	S
R250	RESISTOR 15.0Kohm 1% .125W 100PPM 1206	5322 116 82261	S
R251	RESISTOR 560 ohm 1% .125W 100PPM 1206	4822 051 10561	S
R252	RESISTOR 4.70kohm 1% .125W 100PPM 1206	4822 051 54702	S
R253	RESISTOR 120 ohm 1% 0.125W 100PPM 1206	4822 051 10121	S
R254	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R255	RESISTOR 4.70kohm 1% .125W 100PPM 1206	4822 051 54702	S
R256	RESISTOR 270 ohm 1% .125W 100PPM 1206	4822 051 10271	S
R257	RESISTOR 150 ohm 1% 0.125W 100PPM 1206	4822 051 51501	S
R258	RESISTOR 1.50kohm 1% 0.125W 100PPM 1206	4822 051 51502	S
R259	RESISTOR 470 ohm 1% .125W 100PPM 1206	4822 051 54701	S
R26	RESISTOR 330 ohm 1% .125W 100PPM 1206	4822 051 53301	S
R260	RESISTOR 470 ohm 1% .125W 100PPM 1206	4822 051 54701	S
R261	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R263	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R264	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R265	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R266	RESISTOR 27.0 ohm 1% .125W 100PPM 1206	5322 116 82262	S
R269	RESISTOR 3.30kohm 1% .125W 100PPM 1206	4822 051 53302	S
R27	RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206	5322 117 10858	S
R270	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R271	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R273	RESISTOR 22 ohm 1% .125W 100PPM 1206	4822 051 10229	S
R274	RESISTOR 22 ohm 1% .125W 100PPM 1206	4822 051 10229	S
R276	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R277	RESISTOR 180.0ohm 1% .125W 100PPM 1206	4822 051 10181	S
R278	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R279	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R28	RESISTOR 56.0kohm 1% .125W 100PPM 1206	5322 117 10971	S
R280	RESISTOR 27.0 ohm 1% .125W 100PPM 1206	5322 116 82262	S
R282	RESISTOR 220.0ohm 1% .125W 100PPM 1206	4822 051 52201	S
R283	RESISTOR 470 ohm 1% .125W 100PPM 1206	4822 051 54701	S
R284	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R285	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R286	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R287	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R288	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R289	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R29	RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206	5322 117 10858	S
R290	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R293	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R295	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R296	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R297	RESISTOR 220.0ohm 1% .125W 100PPM 1206	4822 051 52201	S

Pos	Description	Part Number	☆
R298	RESISTOR 220.0ohm 1% .125W 100PPM 1206	4822 051 52201	S
R299	RESISTOR 6.80kohm 1% .125W 100PPM 1206	4822 051 10682	S
R30	RESISTOR 47.0kohm 0.5% 0.125W RC-03G 1206	5322 117 10857	S
R300	RESISTOR 6.80kohm 1% .125W 100PPM 1206	4822 051 10682	S
R301	RESISTOR 820 ohm 1% .125W 100PPM 1206	5322 116 82264	S
R302	RESISTOR 820 ohm 1% .125W 100PPM 1206	5322 116 82264	S
R303	RESISTOR 150 ohm 1% 0.125W 100PPM 1206	4822 051 51501	S
R304	RESISTOR 150 ohm 1% 0.125W 100PPM 1206	4822 051 51501	S
R305	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R306	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R307	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R308	POTENTIOMETER 20kohm 10% 3323P-1-203-10	5322 101 11074	S
R309	RESISTOR 68.0kohm 1% .125W 100PPM 1206	4822 051 56803	S
R31	RESISTOR 330 kohm 1% .125W 100PPM 1206	5322 117 10969	S
R310	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R311	POTENTIOMETER 20kohm 10% 3323P-1-203-10	5322 101 11074	S
R312	RESISTOR 68.0kohm 1% .125W 100PPM 1206	4822 051 56803	S
R313	RESISTOR 3.30kohm 1% .125W 100PPM 1206	4822 051 53302	S
R314	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R316	RESISTOR 3.30kohm 1% .125W 100PPM 1206	4822 051 53302	S
R317	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R319	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R32	RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206	5322 117 10858	S
R320	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R321	RESISTOR 10 Kohm 0.1% 0.25W MPR24	5322 116 82868	S
R322	RESISTOR 10 Kohm 0.1% 0.25W MPR24	5322 116 82868	S
R323	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R324	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R325	RESISTOR 680 ohm 1% .125W 100PPM 1206	4822 051 56801	S
R326	RESISTOR 680 ohm 1% .125W 100PPM 1206	4822 051 56801	S
R327	RESISTOR 680 ohm 1% .125W 100PPM 1206	4822 051 56801	S
R328	RESISTOR 0 ohm BYGLING RC-01 1206	4822 051 10008	S
R329	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R330	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R331	POTENTIOMETER 20kohm 10% 3323P-1-203-10	5322 101 11074	S
R332	RESISTOR 22.0kohm 1% .125W 100PPM 1206	4822 051 52203	S
R334	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R335	RESISTOR 180.0ohm 1% .125W 100PPM 1206	4822 051 10181	S
R336	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R337	THERMISTOR 16.0ohm 20% 3.5A S236/16	5322 116 30457	S
R339	RESISTOR 180.0ohm 1% .125W 100PPM 1206	4822 051 10181	S
R34	RESISTOR 56.0kohm 1% .125W 100PPM 1206	5322 117 10971	S
R340	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R341	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R342	RESISTOR 470 ohm 1% .125W 100PPM 1206	4822 051 54701	S
R344	RESISTOR 2.20kohm 1% .125W 100PPM 1206	4822 051 52202	S
R345	RESISTOR 15.0Kohm 1% .125W 100PPM 1206	5322 116 82261	S
R346	RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206	5322 117 10858	S
R347	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R348	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R349	RESISTOR 220.0ohm 1% .125W 100PPM 1206	4822 051 52201	S
A			
R349	RESISTOR 220.0ohm 1% .125W 100PPM 1206	4822 051 52201	S
B			
R349	RESISTOR 220.0ohm 1% .125W 100PPM 1206	4822 051 52201	S
C			
R349	RESISTOR 220.0ohm 1% .125W 100PPM 1206	4822 051 52201	S
D			
R349	RESISTOR 220.0ohm 1% .125W 100PPM 1206	4822 051 52201	S
E			
R35	RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206	5322 117 10858	S
R350	RESISTOR 15.0Kohm 1% .125W 100PPM 1206	5322 116 82261	S
R352	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R353	RESISTOR 0.22 ohm 5% 0.125W LRC01 3.2x1.6	5322 117 11786	R
R354	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R355	RESISTOR 1.00Mohm 1% 0.125W 100PPM 1206	4822 051 10105	S
R356	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R357	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R358	RESISTOR 33.0kohm 1% .125W 100PPM 1206	4822 051 53303	S
R359	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R36	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R360	RESISTOR 1.80kohm 1% .125W 100PPM 1206	4822 051 10182	S
R361	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R365	RESISTOR 560 ohm 1% .125W 100PPM 1206	4822 051 10561	S
R366	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R367	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R368	RESISTOR 82 ohm 1% .125W 100PPM 1206	4822 051 10829	S
R369	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R37	RESISTOR 2.70kohm 1% .125W 100PPM 1206	4822 051 52702	S
R370	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R371	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R372	RESISTOR 390 ohm 1% .125W 100PPM 1206	4822 051 53901	S
R373	RESISTOR 560 ohm 1% .125W 100PPM 1206	4822 051 10561	S
R374	RESISTOR 2.20kohm 1% .125W 100PPM 1206	4822 051 52202	S
R375	RESISTOR 560 ohm 1% .125W 100PPM 1206	4822 051 10561	S
R377	RESISTOR 4.70kohm 1% .125W 100PPM 1206	4822 051 54702	S
R378	RESISTOR 4.70kohm 1% .125W 100PPM 1206	4822 051 54702	S
R379	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R38	RESISTOR 1.80kohm 1% .125W 100PPM 1206	4822 051 10182	S
R380	RESISTOR 4.70kohm 1% .125W 100PPM 1206	4822 051 54702	S
R381	POTENTIOMETER 1kohm 20% 3323P-1-102	4822 101 10792	S
R382	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R383	RESISTOR 330 ohm 1% .125W 100PPM 1206	4822 051 53301	S
R384	POTENTIOMETER 20kohm 10% 3323P-1-203-10	5322 101 11074	S
R385	RESISTOR 3.30kohm 1% .125W 100PPM 1206	4822 051 53302	S
R386	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R387	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R388	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S

Pos	Description	Part Number	☆
R39	RESISTOR 220.0ohm 1% .125W 100PPM 1206	4822 051 52201	S
R4	RESISTOR 47.0kohm 0.5% 0.125W RC-03G 1206	5322 117 10857	S
R40	RESISTOR 1.50kohm 1% 0.125W 100PPM 1206	4822 051 51502	S
R402	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R403	RESISTOR 820 ohm 1% .125W 100PPM 1206	5322 116 82264	S
R404	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R405	FILTER-EMI BLM31A601SPT Z=600ohm 0.2A 1206	2422 549 42404	
R407	RESISTOR 330 ohm 1% .125W 100PPM 1206	4822 051 53301	S
R409	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R41	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R42	RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206	5322 117 10858	S
R426	RESISTOR 680 ohm 1% .125W 100PPM 1206	4822 051 56801	S
R427	RESISTOR 680 ohm 1% .125W 100PPM 1206	4822 051 56801	S
R428	RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206	5322 117 10858	S
R429	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R43	RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206	5322 117 10858	S
R430	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R431	RESISTOR 27.0 ohm 1% .125W 100PPM 1206	5322 116 82262	S
R432	RESISTOR 82 ohm 1% .125W 100PPM 1206	4822 051 10829	S
R433	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R435	RESISTOR 82 ohm 1% .125W 100PPM 1206	4822 051 10829	S
R436	RESISTOR 82 ohm 1% .125W 100PPM 1206	4822 051 10829	S
R437	RESISTOR 270 ohm 1% .125W 100PPM 1206	4822 051 10271	S
R438	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R439	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R44	POTENTIOMETER 20kohm 10% 3323P-1-203-10	5322 101 11074	S
R440	RESISTOR 2.20kohm 1% .125W 100PPM 1206	4822 051 52202	S
R441	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R442	RESISTOR 1.80kohm 1% .125W 100PPM 1206	4822 051 10182	S
R443	RESISTOR 3.90kohm 1% .125W 100PPM 1206	4822 051 53902	S
R444	RESISTOR 47.0kohm 0.5% 0.125W RC-03G 1206	5322 117 10857	S
R445	RESISTOR 220 kohm 1% .125W 100PPM 1206	4822 051 52204	S
R446	POTENTIOMETER 1kohm 20% 3323P-1-102	4822 101 10792	S
R447	RESISTOR 3.30kohm 1% .125W 100PPM 1206	4822 051 53302	S
R448	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R449	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R45	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R450	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R451	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R452	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R453	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R454	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R455	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R456	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R46	RESISTOR 390 ohm 1% .125W 100PPM 1206	4822 051 53901	S
R460	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R461	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R462	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R463	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R464	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R465	RESISTOR 4.7 ohm 10% 0.25W RC-01 1206	4833 051 10478	S
R466	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R467	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R468	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R469	RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206	4822 051 10109	S
R47	RESISTOR 390 ohm 1% .125W 100PPM 1206	4822 051 53901	S
R470	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R471	RESISTOR 2.7ohm 5% 0.25W RC-01 1206	4822 051 10278	S
R472	RESISTOR 2.7ohm 5% 0.25W RC-01 1206	4822 051 10278	S
R473	RESISTOR 2.7ohm 5% 0.25W RC-01 1206	4822 051 10278	S
R474	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R475	RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206	4822 051 10109	S
R476	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R477	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R478	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R479	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R48	RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206	5322 117 10858	S
R480	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R481	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R482	VARISTOR 95V 95VRMS4.1J	5322 116 21222	S
R483	RESISTOR 4.70kohm 1% .125W 100PPM 1206	4822 051 54702	S
R484	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R485	RESISTOR 22.0kohm 1% .125W 100PPM 1206	4822 051 52203	S
R486	RESISTOR 8.20kohm 1% .125W 100PPM 1206	4822 051 10822	S
R488	RESISTOR 150 ohm 1% 0.1W 100PPM 0805	4031 002 15010	
B			
R489	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R49	RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206	5322 117 10858	S
R491	RESISTOR 2.20kohm 1% .125W 100PPM 1206	4822 051 52202	S
R492	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R493	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R494	RESISTOR 2.20kohm 1% .125W 100PPM 1206	4822 051 52202	S
R495	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R496	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R497	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R498	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R499	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R5	RESISTOR 330 kohm 1% .125W 100PPM 1206	5322 117 10969	S
R50	RESISTOR 15.0Kohm 1% .125W 100PPM 1206	5322 116 82261	S
R500	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R501	RESISTOR 2.20kohm 1% .125W 100PPM 1206	4822 051 52202	S
R502	RESISTOR 2.20kohm 1% .125W 100PPM 1206	4822 051 52202	S
R503	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R504	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R508	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S

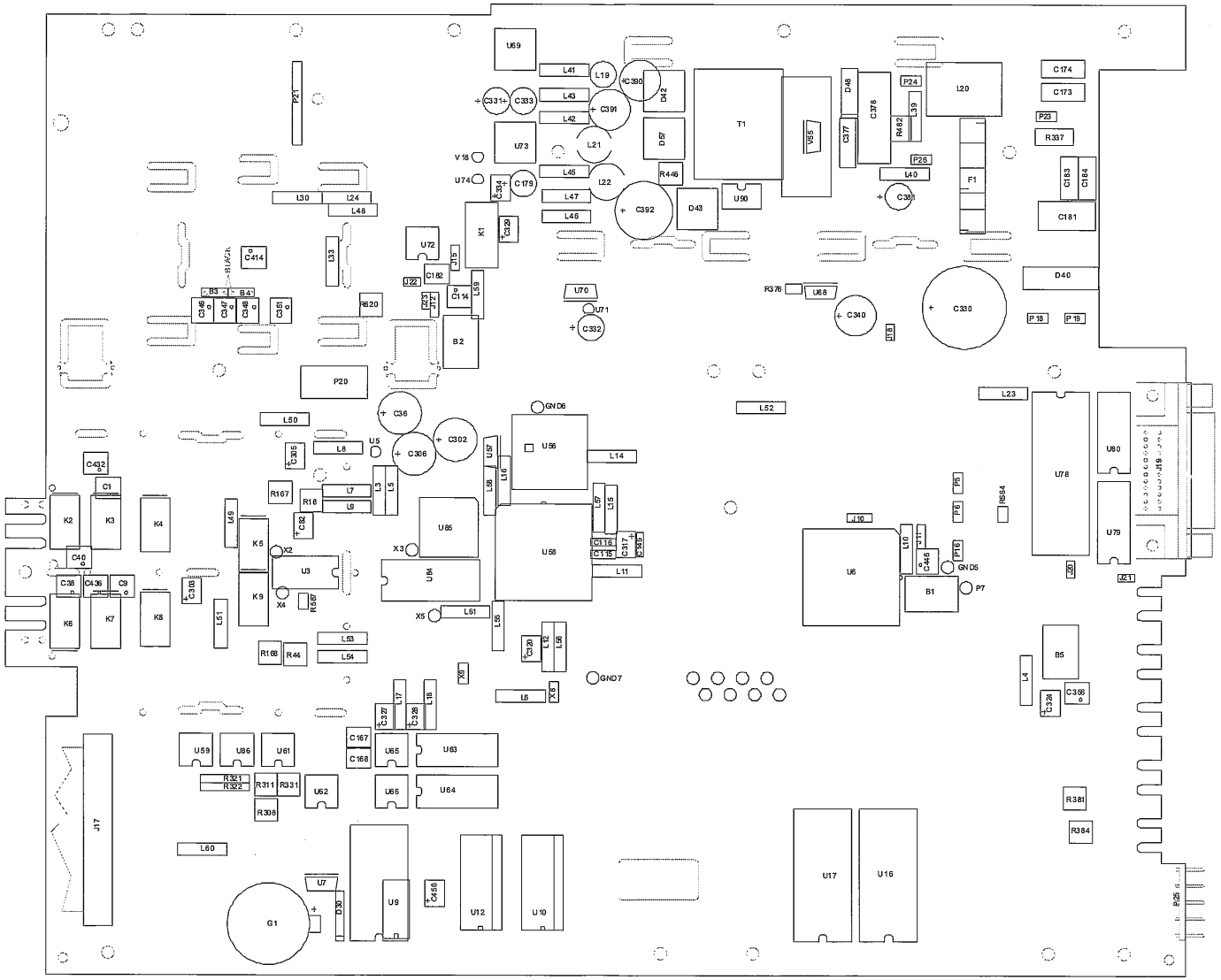
Pos	Description	Part Number	☆
R51	RESISTOR 330 ohm 1% .125W 100PPM 1206	4822 051 53301	S
R514	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R515	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R516	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R517	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R518	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R519	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R52	RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206	5322 117 10858	S
R520	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R521	RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206	4822 051 10109	S
R522	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R523	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R524	RESISTOR 2.20kohm 1% .125W 100PPM 1206	4822 051 52202	S
R525	RESISTOR 220.0ohm 1% .125W 100PPM 1206	4822 051 52201	S
R527	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R528	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R529	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R53	RESISTOR 56.0kohm 1% .125W 100PPM 1206	5322 117 10971	S
R530	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R531	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R535	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R536	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R537	RESISTOR 120 ohm 1% 0.125W 100PPM 1206	4822 051 10121	S
R538	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R54	RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206	5322 117 10858	S
R544	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R545	RESISTOR 47.0kohm 0.5% 0.125W RC-03G 1206	5322 117 10857	S
R546	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R547	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R548	RESISTOR 330 kohm 1% .125W 100PPM 1206	5322 117 10969	S
R549	RESISTOR 330 kohm 1% .125W 100PPM 1206	5322 117 10969	S
R55	RESISTOR 150 ohm 1% 0.125W 100PPM 1206	4822 051 51501	S
R550	RESISTOR 18.0kohm 1% .125W 100PPM 1206	5322 117 10034	S
R551	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R552	RESISTOR 2.20kohm 1% .125W 100PPM 1206	4822 051 52202	S
R553	RESISTOR 2.20kohm 1% .125W 100PPM 1206	4822 051 52202	S
R555	RESISTOR 10 Mohm 10% 0.25W RC-01 1206	4822 051 10106	S
R556	RESISTOR 47.0kohm 0.5% 0.125W RC-03G 1206	5322 117 10857	S
R557	RESISTOR 4.70kohm 1% .125W 100PPM 1206	4822 051 54702	S
R558	RESISTOR 2.7ohm 5% 0.25W RC-01 1206	4822 051 10278	S
R559	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R56	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R560	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R561	RESISTOR 270 ohm 1% .125W 100PPM 1206	4822 051 10271	S
R562	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R563	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R564	THERMISTOR 2.2Kohm 3% 0.25W NTC	5322 116 30458	S
R566	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R567	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R568	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R569	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R57	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R570	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R571	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R574	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R577	RESISTOR 220.0ohm 1% .125W 100PPM 1206	4822 051 52201	S
R578	RESISTOR 220.0ohm 1% .125W 100PPM 1206	4822 051 52201	S
R579	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R58	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R580	RESISTOR 3.30kohm 1% .125W 100PPM 1206	4822 051 53302	S
R581	RESISTOR 4.70kohm 1% .125W 100PPM 1206	4822 051 54702	S
R582	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R583	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R584	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R585	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R586	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R587	THERMISTOR 2.2Kohm 3% 0.25W NTC	5322 116 30458	S
R588	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R589	RESISTOR 1.00Mohm 1% 0.125W 100PPM 1206	4822 051 10105	S
R59	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R590	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R591	RESISTOR 100 ohm 1% 0.1W 100PPM 0805 B	5322 117 12497	S
R592	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R593	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R594	RESISTOR 820 ohm 1% .125W 100PPM 1206	5322 116 82264	S
R595	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R598	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R599	RESISTOR 2.20kohm 1% .125W 100PPM 1206	4822 051 52202	S
R6	RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206	5322 117 10858	S
R60	RESISTOR 470 ohm 1% .125W 100PPM 1206	4822 051 54701	S
R600	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R601	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R602	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R603	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R604	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R605	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R606	RESISTOR 100kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R607	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R608	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R609	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R61	RESISTOR 390 ohm 1% .125W 100PPM 1206	4822 051 53901	S
R610	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R611	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R612	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R613	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R614	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R615	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R616	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R617	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R618	RESISTOR 2.20kohm 1% .125W 100PPM 1206	4822 051 52202	S
R619	RESISTOR 68.0kohm 1% .125W 100PPM 1206	4822 051 56803	S
R62	RESISTOR 390 ohm 1% .125W 100PPM 1206	4822 051 53901	S
R620	POTENTIOMETER 20kohm 10% 3323P-1-203-10	5322 101 11074	S
R621	RESISTOR 68.0kohm 1% .125W 100PPM 1206	4822 051 56803	S
R622	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R623	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R624	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R625	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R626	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R63	RESISTOR 220.0ohm 1% .125W 100PPM 1206	4822 051 52201	S
R64	RESISTOR 68 ohm 1% .125W 100PPM 1206	4822 051 10689	S
R65	RESISTOR 68 ohm 1% .125W 100PPM 1206	4822 051 10689	S
R66	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R67	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R68	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R69	RESISTOR 82 ohm 1% .125W 100PPM 1206	4822 051 10829	S
R7	RESISTOR 56.0kohm 1% .125W 100PPM 1206	5322 117 10971	S
R70	RESISTOR 150 ohm 1% 0.125W 100PPM 1206	4822 051 51501	S
R71	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R72	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R73	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R74	RESISTOR 10.0kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R75	RESISTOR 470 ohm 1% .125W 100PPM 1206	4822 051 54701	S
R76	RESISTOR 390 ohm 1% .125W 100PPM 1206	4822 051 53901	S
R77	RESISTOR 390 ohm 1% .125W 100PPM 1206	4822 051 53901	S
R78	RESISTOR 220.0ohm 1% .125W 100PPM 1206	4822 051 52201	S
R79	RESISTOR 68 ohm 1% .125W 100PPM 1206	4822 051 10689	S
R8	RESISTOR 470.0Kohm 0.5% 0.125W RC-03G 1206	5322 117 10858	S
R80	RESISTOR 68 ohm 1% .125W 100PPM 1206	4822 051 10689	S
R81	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R82	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R83	RESISTOR 1.00kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R84	RESISTOR 82 ohm 1% .125W 100PPM 1206	4822 051 10829	S
R85	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R86	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R87	RESISTOR 82 ohm 1% .125W 100PPM 1206	4822 051 10829	S
R88	RESISTOR 82 ohm 1% .125W 100PPM 1206	4822 051 10829	S
R90	RESISTOR 82 ohm 1% .125W 100PPM 1206	4822 051 10829	S
R91	RESISTOR 15.0ohm 1% .125W 100PPM 1206	4822 051 10159	S
R92	RESISTOR 82 ohm 1% .125W 100PPM 1206	4822 051 10829	S
R94	RESISTOR 15.0ohm 1% .125W 100PPM 1206	4822 051 10159	S
R95	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R96	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R97	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R98	RESISTOR 1.0 ohm 1% 0.125W 100PPM 1206	5322 117 10967	
R99	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
T1	TRANSFORMER PM6680-Ser New PS	5322 148 20035	P
U02	IC PC74HC574T SO20	4822 209 60451	S
U1	IC-OP AMP CA3140AM CA3140 AM BIMOS SO8	9322 114 39682	
U10	IC-SRAM IS61C3216-20K SMD 32K*8 SOJ-44	9322 165 95701	
U100	IC-CMOS 74AC08D 4XAND2 SO14 SMD	5322 209 33102	S
U12	IC-SRAM IS61C3216-20K SMD 32K*8 SOJ-44	9322 165 95701	
U14	IC-CMOS MC74AC573DW 8 LATCH SO20 SMD	5322 209 90435	S
U15	IC-CMOS MC74AC573DW 8 LATCH SO20 SMD	5322 209 90435	S
U16	IC SOCKET 32 POL 644 018-3	5322 255 40921	S
U17	IC SOCKET 32 POL 644 018-3	5322 255 40921	S
U18	IC PC74HC574T SO20	4822 209 60451	S
U19	IC PC74HC574T SO20	4822 209 60451	S
U2	IC-OP AMP CA3140AM CA3140 AM BIMOS SO8	9322 114 39682	
U20	IC-CMOS MC74AC573DW 8 LATCH SO20 SMD	5322 209 90435	S
U21	IC-CMOS SMD 74AC11 SO14 31NP AND	9322 166 59682	
U22	IC-CMOS SMD 74AC11 SO14 31NP AND	9322 166 59682	
U23	IC-CMOS SMD 74AC11 SO14 31NP AND	9322 166 59682	
U24	IC-CMOS 74AC20SC SMD SO14 2XNAND4	5322 209 90427	S
U25	IC-CMOS 74AC20SC SMD SO14 2XNAND4	5322 209 90427	S
U26	IC-CMOS 74AC08D 4XAND2 SO14 SMD	5322 209 33102	S
U27	IC-CMOS 74AC08D 4XAND2 SO14 SMD	5322 209 33102	S
U28	IC-CMOS 74AC86D 4XEXOR2 SO14 SMD	5322 209 33103	S
U29	IC-CMOS SMD 74VHC27 SO14 31NP NOR	9322 166 60682	
U3	IC-COMP AD96687BQ DIL16	4031 105 03250	
U30	IC-CMOS SMD 74VHC27 SO14 31NP NOR	9322 166 60682	
U31	IC-CMOS 74AC02D 4XNOR2 SO14 SMD	5322 209 33101	S
U32	IC-CMOS 74AC32D 4X0R2 SO14 SMD	5322 209 33104	S
U33	IC-CMOS 74AC32D 4X0R2 SO14 SMD	5322 209 33104	S
U34	IC-CMOS 74AC32D 4X0R2 SO14 SMD	5322 209 33104	S
U35	IC-CMOS 74AC32D 4X0R2 SO14 SMD	5322 209 33104	S
U36	IC PC74HC138T SO16	5322 209 73178	S
U37	IC-CMOS 74AC74-D 2xD-FF SO-14 SMD	5322	S
U38	IC-CMOS 74AC74-D 2xD-FF SO-14 SMD	5322	S
U39	IC-CMOS SMD 74AC191 SO16 UP/DOWN COUNTER	9322 165 21701	
U40	IC-CMOS 74AC74-D 2xD-FF SO-14 SMD	5322	S
U41	IC-CMOS SMD 74AC191 SO16 UP/DOWN COUNTER	9322 165 21701	
U44	IC-CMOS MC74AC573DW 8 LATCH SO20 SMD	5322 209 90435	S
U45	IC-CMOS 74AC02D 4XNOR2 SO14 SMD	5322 209 33101	S
U47	IC-CMOS 74AC02D 4XNOR2 SO14 SMD	5322 209 33101	S
U48	IC-CMOS 74AC02D 4XNOR2 SO14 SMD	5322 209 33101	S
U49	IC-CMOS 74AC02D 4XNOR2 SO14 SMD	5322 209 33101	S
U5	IC-REG TL431C-LP TO92	4822 209 81397	S
U50	IC-CMOS 74AC02D 4XNOR2 SO14 SMD	5322 209 33101	S
U51	IC-CMOS CD74AC02M SO14 SMD	9322 181 05682	
U52	IC-CMOS 74AC74-D 2xD-FF SO-14 SMD	5322	S
U53	IC-CMOS SMD 74AC191 SO16 UP/DOWN COUNTER	9322 165 21701	
U54	IC-CMOS CD74AC02M SO14 SMD	9322 181 05682	
U55	IC PC74HC574T SO20	4822 209 60451	S
U56	IC SOCKET 44 POL PLCC	5322 255 41315	S
U57	IC 1.50 A LM317T TO-220	4822 209 80591	S

Pos	Description	Part Number	☆
U58	IC SOCKET 68 POL PLCC	4031 105 71000	
U59	IC-OP AMP OP177GP DIL-8 LOW OFFSET	9322 170 76682	
U6	IC SOCKET 68 POL PLCC	5322 255 40677	S
U60	IC PC74HC4353T SO20	4822 209 62805	S
U61	IC-OP AMP OP177GP DIL-8 LOW OFFSET	9322 170 76682	
U62	IC-OP AMP OP177GP DIL-8 LOW OFFSET	9322 170 76682	
U63	IC-DAC 12BIT AD7545AKN DIL20	5322 209 62107	S
U64	IC-DAC 12BIT AD7545AKN DIL20	5322 209 62107	S
U65	IC-OP AMP OP177GP DIL-8 LOW OFFSET	9322 170 76682	
U66	IC-OP AMP OP177GP DIL-8 LOW OFFSET	9322 170 76682	
U67	IC NE532D DUAL SO-8	5322 209 71553	S
U69	HEAT SINK 16øK/W LODBAR TO219	5322 255 41313	P
U69	IC 12 V UA7812UC 1A TO-220	5322 209 86176	S
U7	IC 1.50 A LM317T TO-220	4822 209 80591	S
U70	IC 1.50 A LM317T TO-220	4822 209 80591	S
U71	IC-REG TL431C-LP TO92	4822 209 81397	S
U72	IC-OP AMP OP177GP DIL-8 LOW OFFSET	9322 170 76682	
U73	HEAT SINK 16øK/W LODBAR TO220	5322 255 41313	P
U73	IC 1.50 A LM337T TO-220	5322 209 81236	S
U74	IC-REG TL431C-LP TO92	4822 209 81397	S
U75	IC-OP AMP CA3140AM CA3140 AM BIMOS SO8	9322 114 39682	
U76	IC-CMOS 74AC74-D 2xD-FF SO-14 SMD	5322	S
U77	IC NE532D DUAL SO-8	5322 209 71553	S
U78	IC-DIG UPD7210D IEC BUS GPIB CONTROLLER	9322 023 60682	
U79	IC SN75161AN	5322 209 81842	S
U8	IC TL7770-50W	5322 209 30397	S
U80	IC SN75160AN	5322 209 81807	S
U81	IC-CMOS 74AC74-D 2xD-FF SO-14 SMD	5322	S
U82	IC-CMOS SMD 74AC11 SO14 31NP AND	9322 166 59682	
U84	IC-DIG ECL 100304PC 5XAND/NAND2 PDIP24	5322 209 33638	S
U85	IC SOCKET 28 POL 821581-1 PLCC	2422 486 80183	
U85	IC-DIG ECL 100331QC 3XDFLIP-FLOP PCC28	5322 209 33604	S
U86	IC-REF 2.50 V MC1403U DIL-8	5322 209 82864	S
U87	IC-CMOS 74AC20SC SMD SO14 2XNAND4	5322 209 90427	S
U88	IC-BUS TRANSCEIV 75ALS176D SO-8 SMD	5322 209 33171	R
U9	IC-SRAM CY62256LL-70SNC SMD 32K*8 SO28	9322 130 52701	
U90	OPTOCOUPLER CNX82A SEMKO SOT231	4822 130 10025	S
U91	IC-ANA SMPS CTR UC3842AD SO14	5322 209 33169	S
U92	IC-REF 2.5V TL431I-D SO8	5322 209 62422	R
U93	IC-CMOS 74AC02D 4XNOR2 SO14 SMD	5322 209 33101	S
U94	IC-CMOS SMD 74AC86SC SO14 21NP EXOR	9322 167 94682	
U95	IC NE532D DUAL SO-8	5322 209 71553	S
U97	IC- 14C88M SO14	5322 209 33108	S
U98	IC-CMOS 74AC08D 4XAND2 SO14 SMD	5322 209 33102	S
U99	IC NE532D DUAL SO-8	5322 209 71553	S
V1	TRANSISTOR BF513 .03A20V SOT23	4822 130 60686	S
V12	TRANSISTOR BSR12 0.1A 15V SOT23	5322 130 44743	S
V14	TRANSISTOR BSR12 0.1A 15V SOT23	5322 130 44743	S
V15	TRANSISTOR BC847B .1A45V SOT23	4822 130 60511	S
V16	TRANSISTOR BC857B .1A45V SOT23	5322 130 60508	S
V17	TRANSISTOR BC857B .1A45V SOT23	5322 130 60508	S
V18	TRANSISTOR BC369 1A 20V TO92	5322 130 44593	S
V19	TRANSISTOR BFS17 .05A 15V SOT23	5322 130 40781	S
V2	TRANSISTOR BF513 .03A20V SOT23	4822 130 60686	S
V20	TRANSISTOR 25 MA BFR92A 20V SOT23	5322 130 60647	S
V21	TRANSISTOR BF513 .03A20V SOT23	4822 130 60686	S
V22	TRANSISTOR 25 MA BFR92A 20V SOT23	5322 130 60647	S
V23	TRANSISTOR BFG97 0.1A 15V SO223	4822 130 63069	S
V25	TRANSISTOR 25 MA BFR92A 20V SOT23	5322 130 60647	S
V26	TRANSISTOR BFG97 0.1A 15V SO223	4822 130 63069	S
V27	TRANSISTOR BFS17 .05A 15V SOT23	5322 130 40781	S
V28	TRANSISTOR 25 MA BFR92A 20V SOT23	5322 130 60647	S
V29	TRANSISTOR BFG97 0.1A 15V SO223	4822 130 63069	S
V3	TRANSISTOR BFS17 .05A 15V SOT23	5322 130 40781	S
V31	TRANSISTOR 25 MA BFR92A 20V SOT23	5322 130 60647	S
V32	TRANSISTOR BFG97 0.1A 15V SO223	4822 130 63069	S
V33	TRANSISTOR BFS17 .05A 15V SOT23	5322 130 40781	S
V4	TRANSISTOR BFS17 .05A 15V SOT23	5322 130 40781	S
V40	TRANSISTOR BFS17 .05A 15V SOT23	5322 130 40781	S
V41	TRANSISTOR BFS17 .05A 15V SOT23	5322 130 40781	S
V42	TRANSISTOR BFS17 .05A 15V SOT23	5322 130 40781	S
V43	TRANSISTOR BSV52 0.1A 12V SOT23	5322 130 44336	S
V44	TRANSISTOR BC847B .1A45V SOT23	4822 130 60511	S
V45	TRANSISTOR BC847B .1A45V SOT23	4822 130 60511	S
V46	TRANSISTOR BC847B .1A45V SOT23	4822 130 60511	S
V47	TRANSISTOR BC847B .1A45V SOT23	4822 130 60511	S
V48	TRANSISTOR BC847B .1A45V SOT23	4822 130 60511	S
V49	TRANSISTOR BC847B .1A45V SOT23	4822 130 60511	S
V50	TRANSISTOR BC847B .1A45V SOT23	4822 130 60511	S
V51	TRANSISTOR BC847B .1A45V SOT23	4822 130 60511	S
V52	TRANSISTOR BC847B .1A45V SOT23	4822 130 60511	S
V53	TRANSISTOR BC847B .1A45V SOT23	4822 130 60511	S
V54	TRANSISTOR BC847B .1A45V SOT23	4822 130 60511	S
V55	HEAT SINK 13.5øK/W KS35.10-25EL 2x2.3	5322 255 41314	P
V55	TRANSI-POW MOS 4A STP4NC80ZFP TO220FP	9322 164 04701	
V56	TRANSISTOR 0.5A BC807-25 45V SOT23	5322 130 60845	S
V57	TRANSISTOR 0.5A BC817-25 45V SOT23	4822 130 42804	S
V58	TRANSISTOR 0.5A BC817-25 45V SOT23	4822 130 42804	S
V59	TRANSISTOR 0.5A BC817-25 45V SOT23	4822 130 42804	S
V60	TRANSISTOR 0.5A BC817-25 45V SOT23	4822 130 42804	S
V61	TRANSISTOR BC847B .1A45V SOT23	4822 130 60511	S
V62	TRANSISTOR BCP51 1.5A 45V SOT223	5322 130 62639	S
V63	TRANSISTOR 0.5A BC817-25 45V SOT23	4822 130 42804	S
V64	TRANSISTOR 0.5A BC807-25 45V SOT23	5322 130 60845	S
V65	TRANSISTOR BC847B .1A45V SOT23	4822 130 60511	S
V66	TRANSISTOR BC857B .1A45V SOT23	5322 130 60508	S
V67	TRANSISTOR BFS17 .05A 15V SOT23	5322 130 40781	S
V68	TRANSISTOR BFS17 .05A 15V SOT23	5322 130 40781	S
V69	TRANSISTOR BC847B .1A45V SOT23	4822 130 60511	S
V70	TRANSISTOR BC847B .1A45V SOT23	4822 130 60511	S
V8	TRANSISTOR BFS17 .05A 15V SOT23	5322 130 40781	S
V9	TRANSISTOR BSR12 0.1A 15V SOT23	5322 130 44743	S

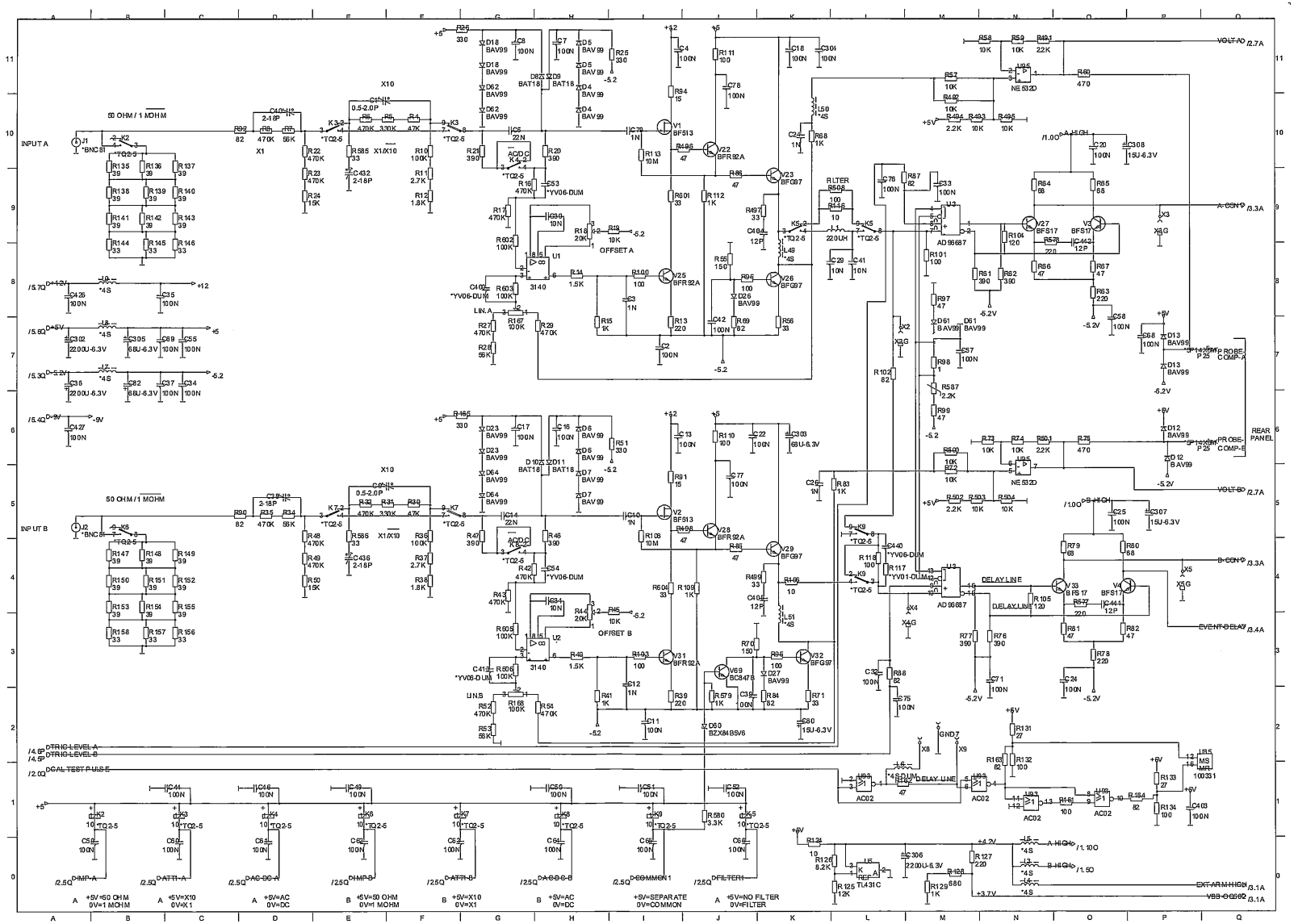
Pos	Description	Part Number	☆
X2	CONNECTOR 3 POL F095 SINGLE ROW	5322 290 60445	S
X4	CONNECTOR 3 POL F095 SINGLE ROW	5322 290 60445	S

Main Board, Component Layout

Top Side

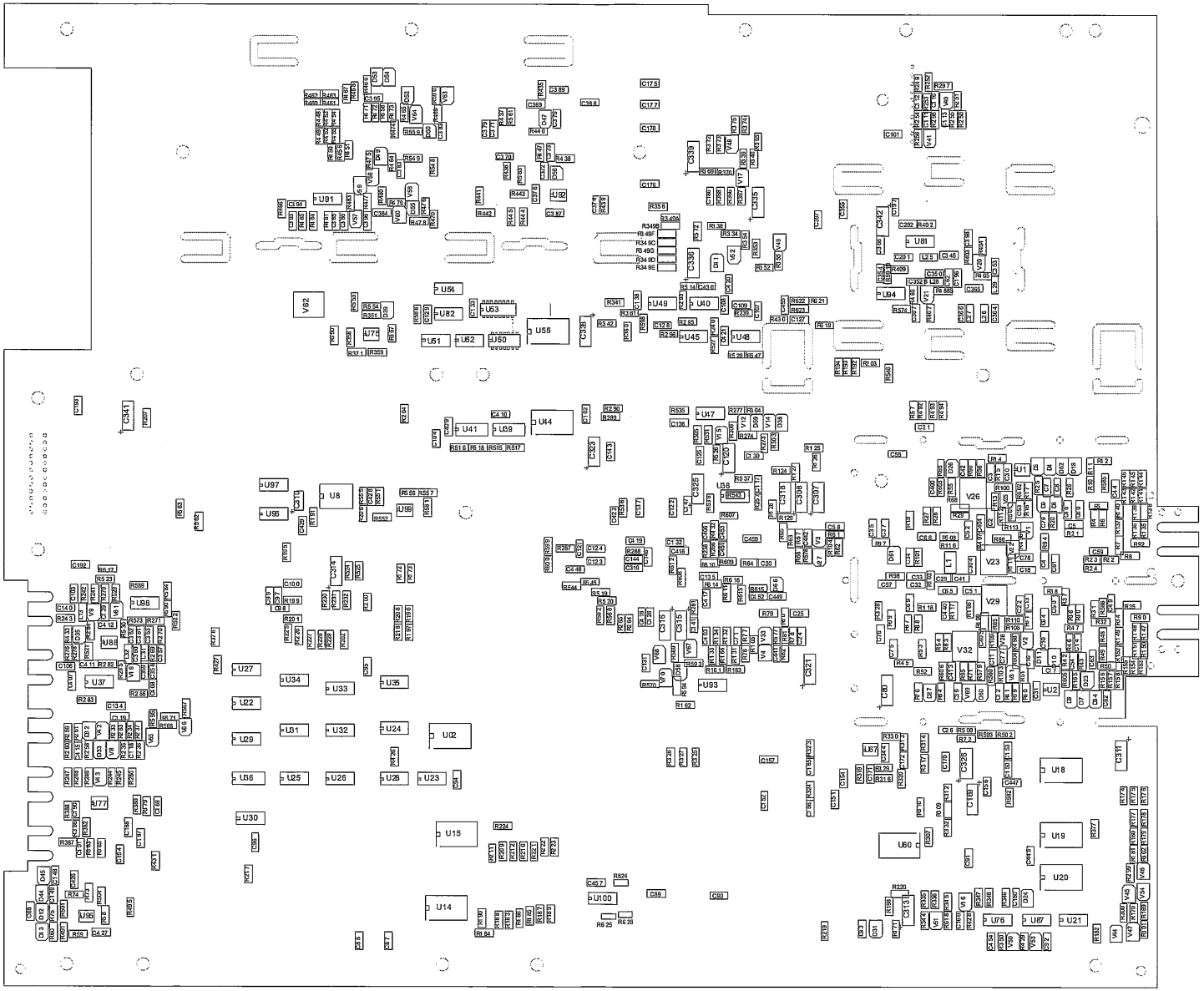


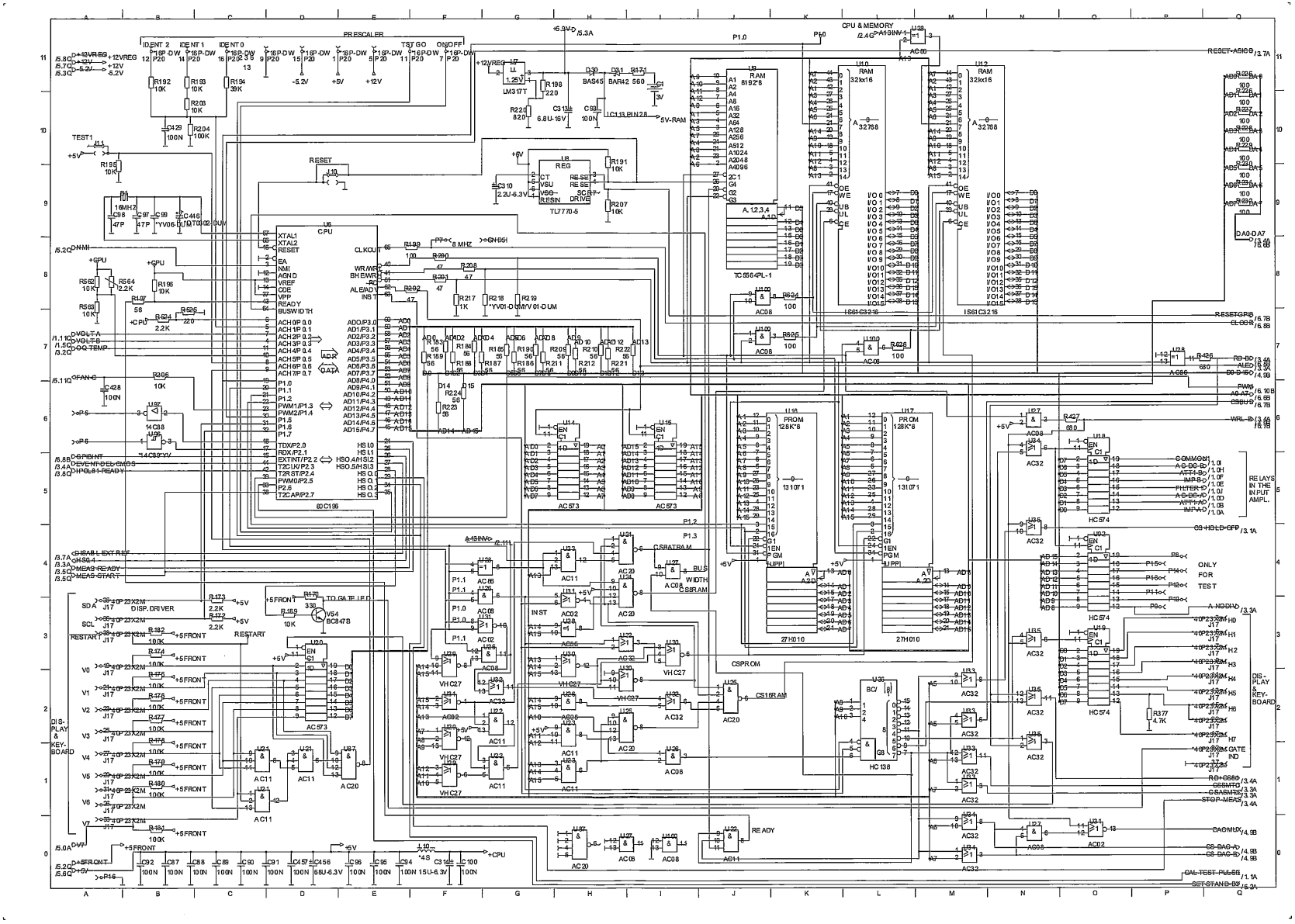
Input Amplifier, Unit 1 sheet 1(6)



Main Board, Component Layout

Bottom Side





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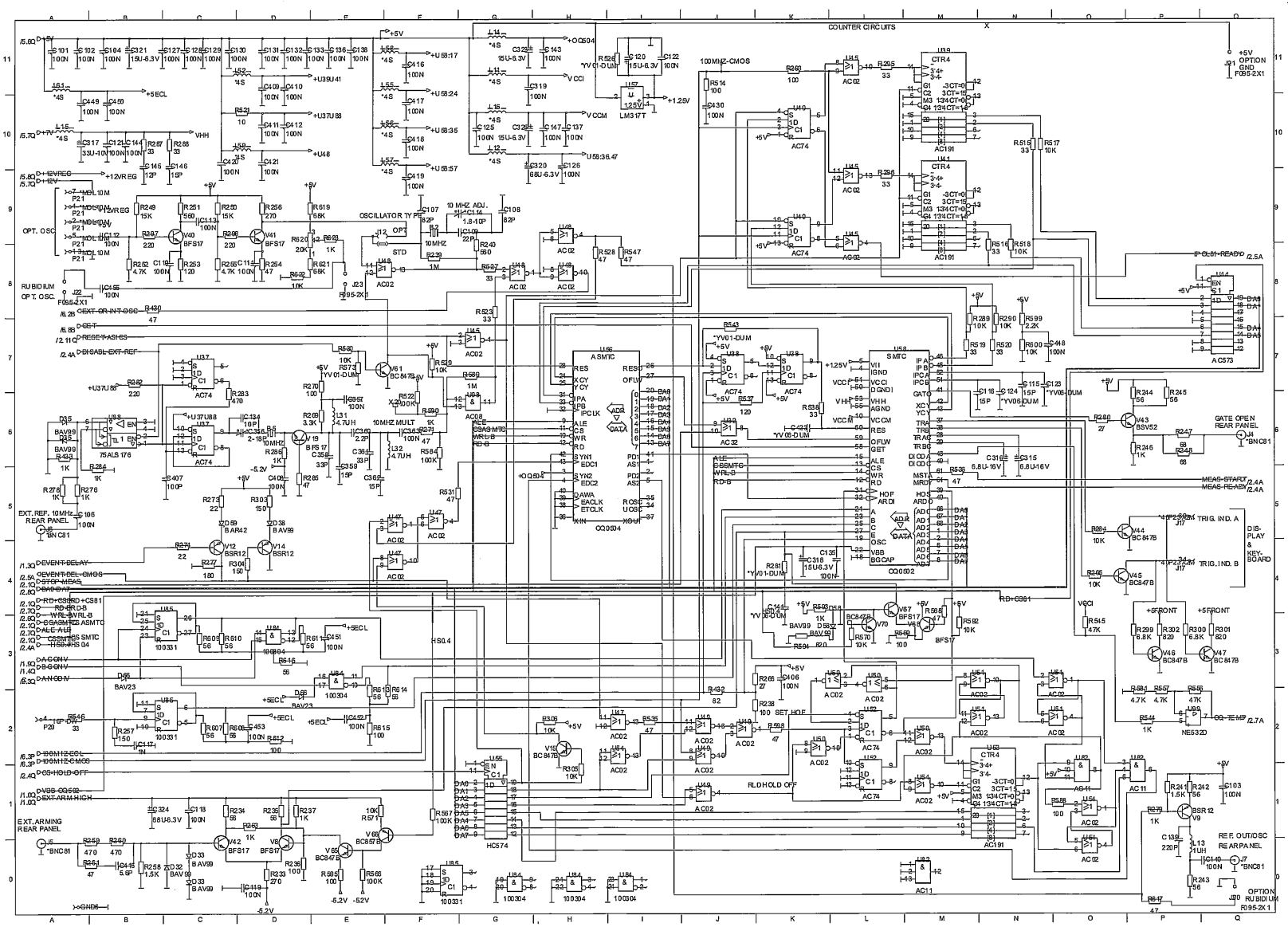
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100MHZ-CMOS
OPT. OSC.
RUBIDIUM OPT. OSC.
OSCILLATOR TYPE
10 MHZ ADJ.
10MHZ MULT
EXT. REF. 10MHz REAR PANEL
EXT.ARMING REAR PANEL
GATE OPEN REAR PANEL
REF. OUT/OSC REAR PANEL
OPTION RUBIDIUM
OPTION GND
TRIG. IND. A
TRIG. IND. B
DISPLAY & KEYBOARD
MEAS-START
MEAS-REARM
RLD HOLD OFF
SET HOF
+5FRONT
LM317
SMTC
ASMTC
HC574
NE532D
BSR12
BC847B
BFS17
BAV99
BAR42
BSV52
BSR12

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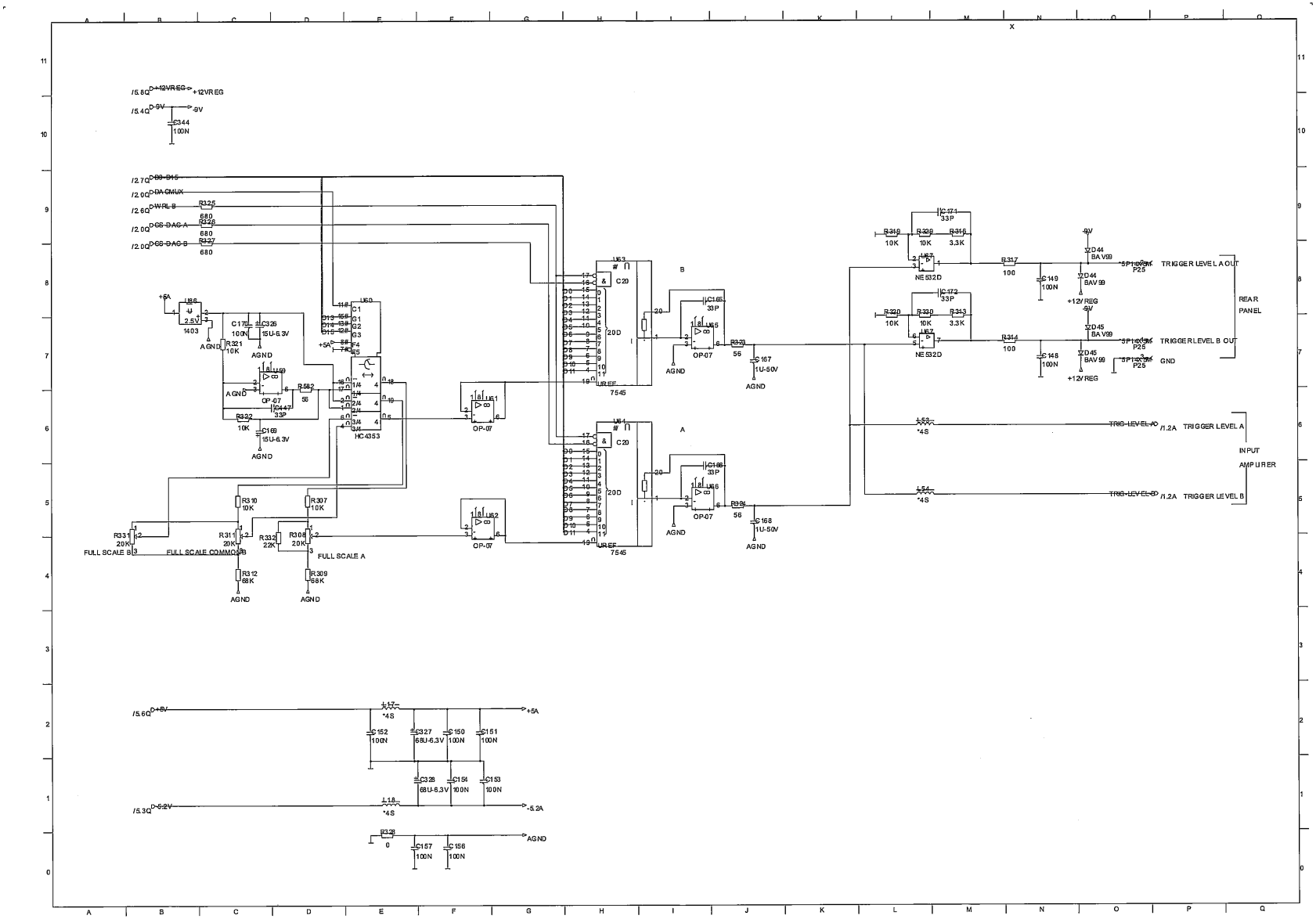
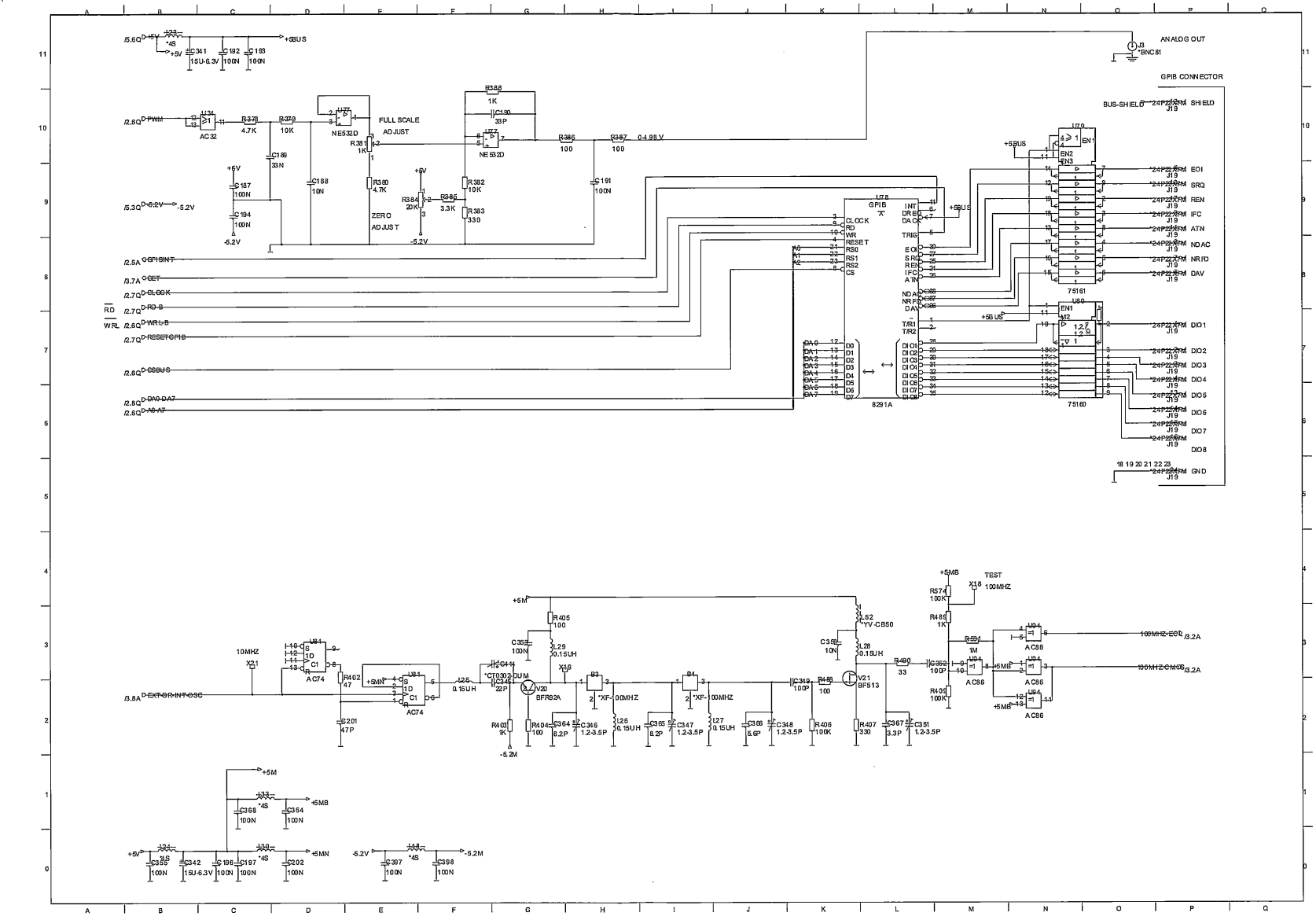

+12VREG
-9V
DB0-D15
DA CMUX
WRL B
CS DAC A
CS DAC B
+5A
AGND
FULL SCALE B
FULL SCALE COMMON
FULL SCALE A
TRIGGER LEVEL A OUT
TRIGGER LEVEL B OUT
GND
REAR PANEL
TRIG-LEVEL-A
TRIG-LEVEL-B
TRIGGER LEVEL A
TRIGGER LEVEL B
INPUT AMPLIFIER
-5.2A


ANALOG OUT
BNC81
GPIB CONNECTOR
BUS-SHIELD
SHIELD
EOI
SRQ
REN
IFC
ATN
NDAC
NRFD
DAV
DIO1
DIO2
DIO3
DIO4
DIO5
DIO6
DIO7
DIO8
GND
GPIB
8291A
75161
75160
FULL SCALE ADJUST
ZERO ADJUST
NE532D
AC32
AC74
AC86
BFR92A
BF513
TEST
100MHZ
10MHZ
EXTORINTOSC
100MHZ-ECL
100MHZ-CMOS
+5V
-5.2V
+5MB
+5M
+5MN
+5BUS

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Model PM6681R

Rubidium Timebase

Introduction

A rubidium timebase (atomic clock reference) is now available in the Model PM6681R Timer/Counter/Analyzer. This oscillator cannot be retrofitted. Due to the power requirements, an additional built-in power supply is needed. It is located on the same board as the distribution amplifiers for the six extra reference outputs included in this instrument.

Performance Check

The general rules in Chapter 2 apply, but observe the additional instructions below.

NOTE: To fully test the accuracy of the PM6681R, access to an extremely high stability reference signal is needed, for example a Cesium Atomic Reference or a transmitted signal from a nationally or internationally traceable source. Additionally the instrument has to be stabilized for a period of one month.

The PM6681R has an UNLOCKED/STANDBY LED. When the LED is lit the Rubidium time base is still in its warm-up phase and is not yet stabilized.

■ Test procedure

– Connect the counter to the line power.

– Check that the UNLOCKED/STANDBY LED is lit.

– Turn on the Timer/Counter

– Check that the UNLOCKED/STANDBY LED is switched off within 5 minutes after connection to line power.

– Connect a 10 MHz reference signal to input A of the counter.

– Select FREQUENCY A measurement.

– Select 1 s measuring time.

– Check that the displayed frequency is 10.00000000 MHz ± 1 LSD < 6 minutes after connection to line power.

NOTE: The rubidium timebase unit must be sent to a Fluke service center for repair. Follow the exchange procedure.

Calibration and Adjustment

NOTE: Before adjusting the oscillator, the timer/counter must have been continuously connected to the ac power line for at least 24 hours.

Required test equipment

Type	Uncertainty	Model
10 MHz reference	$<2x10^{-11}$	Cesium / GPS
Timer/Counter		PM6681
GPIB controller		PC+GPIB+TimeView

■ Setup

– Connect the 10 MHz reference to the REFERENCE IN connector on the rear panel of the timer/counter and make sure that External Reference is selected on the front panel.

– Connect one of the 10 MHz outputs on the rear panel of the PM6681R – the Device Under Test (DUT) – to Input A of the timer/counter.

■ Calibration measurement

– Set the measurement time of the timer/counter to 10 s.

– Select MATH (K*X+L) and set a negative offset of 10 MHz (L = -10E6).

– Select STAT (statistics), N=100, and MEAN.

– Press RESTART. After approx. 17 minutes the mean value over 100 readings is displayed.

NOTE: If a GPS receiver is used as a reference, change number of samples N in the STAT menu to 8640 (instead of 100) to enable a frequency mean value over 24 h (instead of 17 min). GPS receivers have an excellent long-term stability (24 h) but can be quite unstable over shorter periods.

■ Adjustment criteria

If the display reading does not exceed 0.5 mHz ($0.5x10^{-3}$ Hz), no adjustment is required.

■ Adjustment procedure

– Switch off statistics (STAT OFF) in the timer/counter.

– Remove the seal sticker from the front panel of the DUT (below 'Ref Adj' to the left of the PRESET button).

– Adjust the potentiometer behind the seal until the display of the timer/counter shows $0.5x10^{-3}$ Hz or less.

– Repeat the calibration measurement described above to verify the adjustment.

– Check that the value is stable over time (>30 min). TimeView is an excellent tool for viewing frequency stability over time.

– Attach a new calibration seal sticker so that it covers the hole in the front panel.

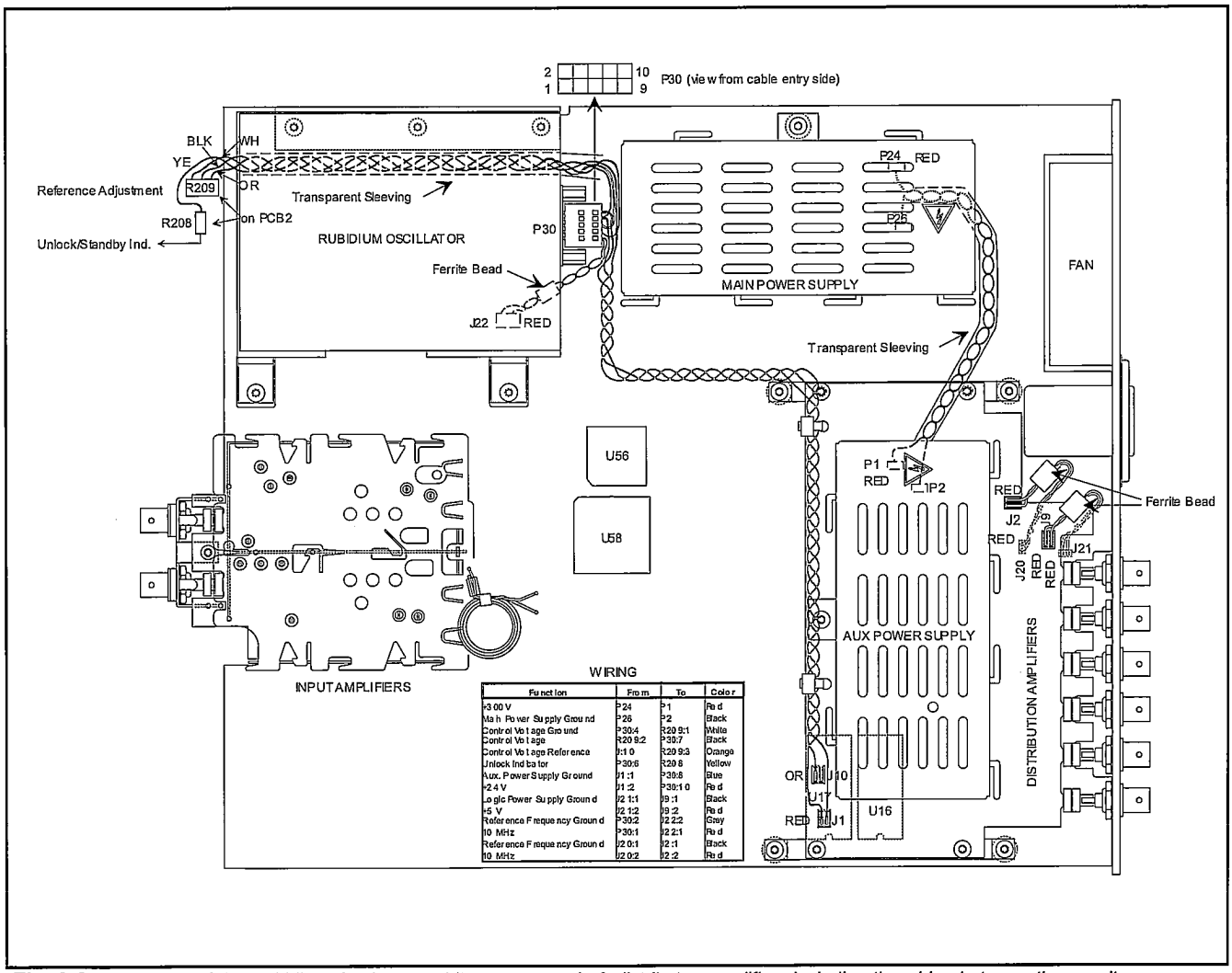

Fig. 9-8 *Location of the Rubidium timebase and its power supply & distributon amplifiers including the wiring between these units.*

OCXO Range Extended

New OCXOs

Oven-Controlled Oscillators, PM9691 & PM9692

The PM9691 is adjusted to 10 MHz ± 0.2 Hz when manufactured, the PM9692 to 10 MHz ± 0.05 Hz, so there is no need to adjust the frequency directly after installation.

These oscillators, like any oscillator, change frequency because of aging. Use the table in the Operators Manual, Chapter 10, to calculate when calibration is due. The complete specifications can be found in the same manual, Chapter 11.

Required test equipment

Instrument	Required specification	Model
Counter with Rubidium Reference	10 MHz ± 0.01 Hz (Uncertainty ≤ $1x10^{-9}$)	PM6681R/ PM6685R

Table 9-1

■ Setup

– Connect the counter to the line power.

– Switch on the counter.

– Set the counter to default settings (preset).

Make the adjustment at an ambient temperature of +23 °C, if possible. The oscillator must have been operating continuously for 48 hours before an adjustment.

– Connect the 10 MHz OUT socket of the counter to be adjusted (rear panel) to the Input A of the PM6681R/PM6685R.

– Set up the PM6681R/PM6685R:
  – Measuring time = 0.5 s
  – 50 Ω input impedance
  – Frequency A measurements

■ Adjustment

The oscillator has a voltage controlled adjustment range. This range is divided into five fixed steps set via DIP switches, and a trimmer to fine-tune the control voltage.

Normally the range of the trimmer should be sufficient to compensate for the aging that occurs during at least two years of operation.

Fine adjustment

– Adjust the trimmer to better than 10 MHz ± 0.2 Hz (PM9691) or 10 MHz ± 0.05 Hz (PM9692), i.e. ±20 resp. ±5 in the last two digits on the PM6681R/PM6685R display.

– If this adjustment is OK, reassemble the counter.

Coarse adjustment

Make this adjustment only if the trimmer range is insufficient to adjust the oscillator.

– Remove the tape from the DIP-switch.

– Adjust the trimmer to its mid position (about 12 turns from either end position).

– Read the frequency on the PM6681R/PM6685R. (Nominal 10.000000 MHz)
  – If the frequency is too low, set the DIP-switches to the next higher voltage range.
  – If the frequency is too high, set the DIP-switches to the next lower voltage range.

Trimmer range (V)	DIP switch number (1 = on, 0 = off)							
	1	2	3	4	5	6	7	8
2.6 - 3.4	0	0	0	1	0	0	0	0
3.2 - 3.9	0	1	0	1	1	0	0	0
3.5 - 4.3	1	0	0	1	1	0	0	0
4.0 - 4.7	1	0	1	1	1	1	0	0
4.1 - 5.0	1	0	1	0	1	1	1	0

Table 9-2 *Coarse adjustment by means of DIP switches.*

– Check that the new trimmer range is about ±2 Hz around 10 MHz.

Adjust the trimmer according to 'Fine adjustment' above.

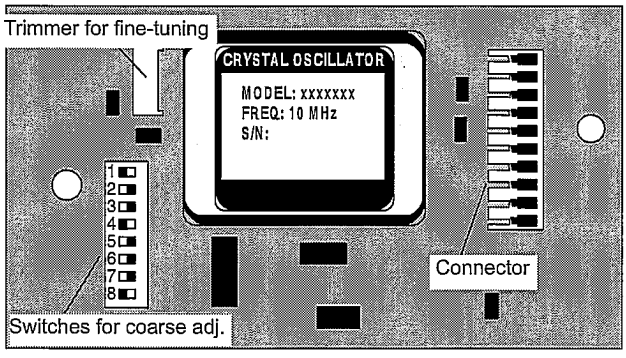

Fig. 9-9 *Adjusting the optional oscillator frequency.*

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Option PM9671B

Introduction

This optional reference output unit replaces the extra 5x10 MHz + 1x5 MHz outputs of the PM6681R and offers more frequencies (1x0.1 MHz, 1x1 MHz, 1x5 MHz and 3x10 MHz with higher output level (1 V_{RMS} versus 0.6 V_{RMS}). The standard 10 MHz, 0.6 V_{RMS} output of PM6681R is not affected.

Performance Check

Connect an oscilloscope to the outputs marked I, J, K, L, M and N and check the frequencies (0.1, 1, 5, 10, 10 and 10 MHz), the waveform (sinusoidal) and the level (>1 V_{RMS}).

Adjustments

No adjustments can be made. The output frequencies are locked to the internal/external timebase, depending on the source selected via the front panel or by means of a GPIB command. The default timebase source is the built-in reference oscillator.

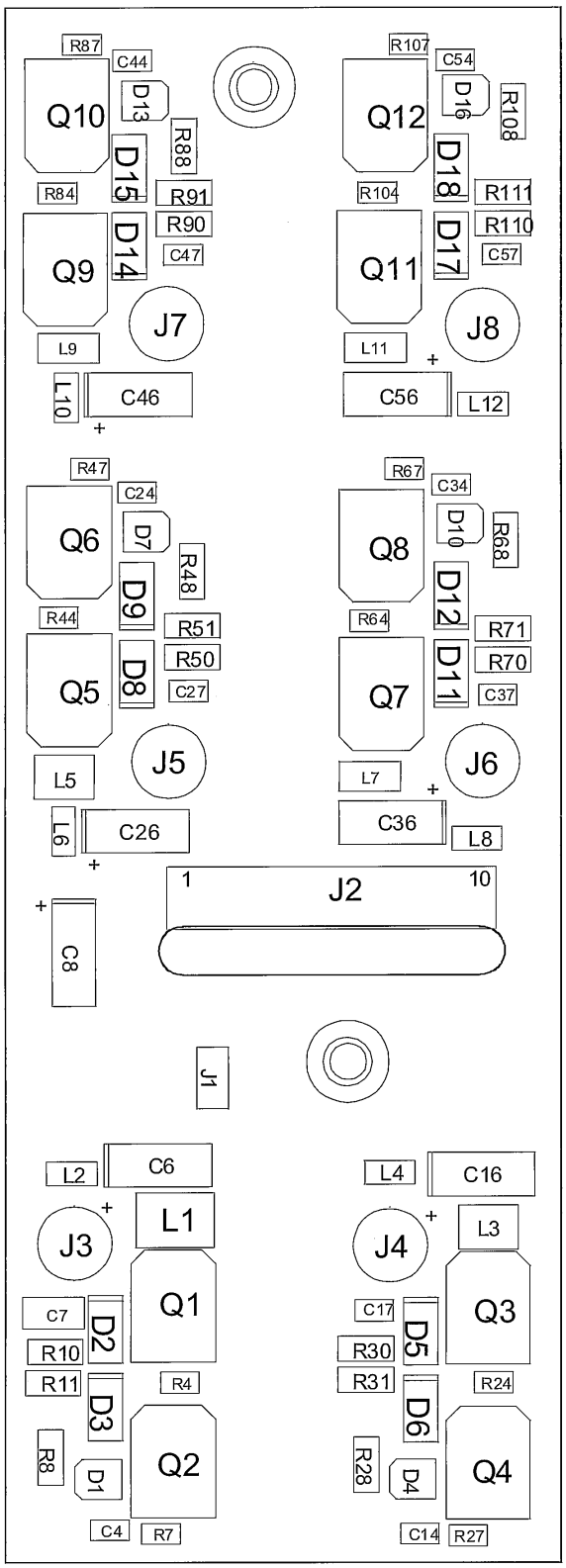
Replacement Parts (PM9671B)

Pos	Description	Part Number	☆
15	LABEL STATUS 25.4X12.7 POLYIMIDE	5322 454 13144	P
27	CONNECTOR 2 POL 640442-2 AWG26 IDT	5322 265 41371	S
C1	CAPACITOR 8.2nF 50V X7R C0805C822K5RAC	2022 552 05597	
C11	CAPACITOR 220pF 5% 50V NP0 0805	4822 122 33575	S
C12	CAPACITOR 820pF ñ5% 50V NP0 0805	2238 861 15821	
C13	CAPACITOR 10nF 20% 50V X7R 0805	5322 122 34098	S
C14	CAPACITOR 100nF 20% 25V X7R 0805	5322 126 13638	S
C15	CAPACITOR 100nF 20% 25V X7R 0805	5322 126 13638	S
C16	CAPACITOR 6.80 µF 20% 16V 6.0X3.2 MOLD	5322 124 10687	R
C17	CAPACITOR 100nF 20% 25V X7R 0805	5322 126 13638	S
C19	CAPACITOR 100nF 20% 25V X7R 0805	5322 126 13638	S
C2	CAPACITOR 8.2nF 50V X7R C0805C822K5RAC	2022 552 05597	
C21	CAPACITOR 47pF 5% 50V NP0 0805	2222 861 15479	
C22	CAPACITOR 150pF 5% 50V NP0 0805	2222 861 15151	
C23	CAPACITOR 1nF 20% 50V X7R 0805	5322 122 34123	S
C24	CAPACITOR 100nF 20% 25V X7R 0805	5322 126 13638	S
C25	CAPACITOR 100nF 20% 25V X7R 0805	5322 126 13638	S
C26	CAPACITOR 6.80 µF 20% 16V 6.0X3.2 MOLD	5322 124 10687	R
C27	CAPACITOR 100nF 20% 25V X7R 0805	5322 126 13638	S
C29	CAPACITOR 100nF 20% 25V X7R 0805	5322 126 13638	S
C3	CAPACITOR 100nF 20% 25V X7R 0805	5322 126 13638	S
C31	CAPACITOR 33pF 5% 50V NP0 0805	2222 861 15339	
C32	CAPACITOR 82pF 5% 50V NP0 0805	2222 861 15829	
C33	CAPACITOR 1nF 20% 50V X7R 0805	5322 122 34123	S
C34	CAPACITOR 100nF 20% 25V X7R 0805	5322 126 13638	S
C35	CAPACITOR 100nF 20% 25V X7R 0805	5322 126 13638	S
C36	CAPACITOR 6.80 µF 20% 16V 6.0X3.2 MOLD	5322 124 10687	R
C37	CAPACITOR 100nF 20% 25V X7R 0805	5322 126 13638	S
C39	CAPACITOR 100nF 20% 25V X7R 0805	5322 126 13638	S
C4	CAPACITOR 100nF 20% 25V X7R 0805	5322 126 13638	S
C41	CAPACITOR 33pF 5% 50V NP0 0805	2222 861 15339	
C42	CAPACITOR 82pF 5% 50V NP0 0805	2222 861 15829	
C43	CAPACITOR 1nF 20% 50V X7R 0805	5322 122 34123	S
C44	CAPACITOR 100nF 20% 25V X7R 0805	5322 126 13638	S
C45	CAPACITOR 100nF 20% 25V X7R 0805	5322 126 13638	S
C46	CAPACITOR 6.80 µF 20% 16V 6.0X3.2 MOLD	5322 124 10687	R
C47	CAPACITOR 100nF 20% 25V X7R 0805	5322 126 13638	S
C49	CAPACITOR 100nF 20% 25V X7R 0805	5322 126 13638	S
C5	CAPACITOR 100nF 20% 25V X7R 0805	5322 126 13638	S
C51	CAPACITOR 33pF 5% 50V NP0 0805	2222 861 15339	
C52	CAPACITOR 82pF 5% 50V NP0 0805	2222 861 15829	
C53	CAPACITOR 1nF 20% 50V X7R 0805	5322 122 34123	S
C54	CAPACITOR 100nF 20% 25V X7R 0805	5322 126 13638	S
C55	CAPACITOR 100nF 20% 25V X7R 0805	5322 126 13638	S
C56	CAPACITOR 6.80 µF 20% 16V 6.0X3.2 MOLD	5322 124 10687	R
C57	CAPACITOR 100nF 20% 25V X7R 0805	5322 126 13638	S
C6	CAPACITOR 6.80 µF 20% 16V 6.0X3.2 MOLD	5322 124 10687	R
C7	CAPACITOR 220nF 10% 63V X7R 1206	5322 126 13642	S
C8	CAPACITOR 15 µF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	S
C9	CAPACITOR 47pF 5% 50V NP0 0805	2222 861 15479	
D1	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D10	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D11	DIODE BYD17G 400V 1.5A SOD87	9338 122 40701	
D12	DIODE BYD17G 400V 1.5A SOD87	9338 122 40701	
D13	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D14	DIODE BYD17G 400V 1.5A SOD87	9338 122 40701	
D15	DIODE BYD17G 400V 1.5A SOD87	9338 122 40701	
D16	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D17	DIODE BYD17G 400V 1.5A SOD87	9338 122 40701	
D18	DIODE BYD17G 400V 1.5A SOD87	9338 122 40701	
D2	DIODE BYD17G 400V 1.5A SOD87	9338 122 40701	
D3	DIODE BYD17G 400V 1.5A SOD87	9338 122 40701	
D4	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D5	DIODE BYD17G 400V 1.5A SOD87	9338 122 40701	
D6	DIODE BYD17G 400V 1.5A SOD87	9338 122 40701	
D7	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D8	DIODE BYD17G 400V 1.5A SOD87	9338 122 40701	
D9	DIODE BYD17G 400V 1.5A SOD87	9338 122 40701	
J2	CONNECTOR 10 POL 22-14-2104 4455-BC	5322 267 50336	S
J3	CONTACT PIN MINICOAX FOR PC-B	5322 268 14141	S
J3	BUSHING MINICOAX FOR PC-B	5322 268 24116	S
J4	CONTACT PIN MINICOAX FOR PC-B	5322 268 14141	S
J4	BUSHING MINICOAX FOR PC-B	5322 268 24116	S
J5	CONTACT PIN MINICOAX FOR PC-B	5322 268 14141	S

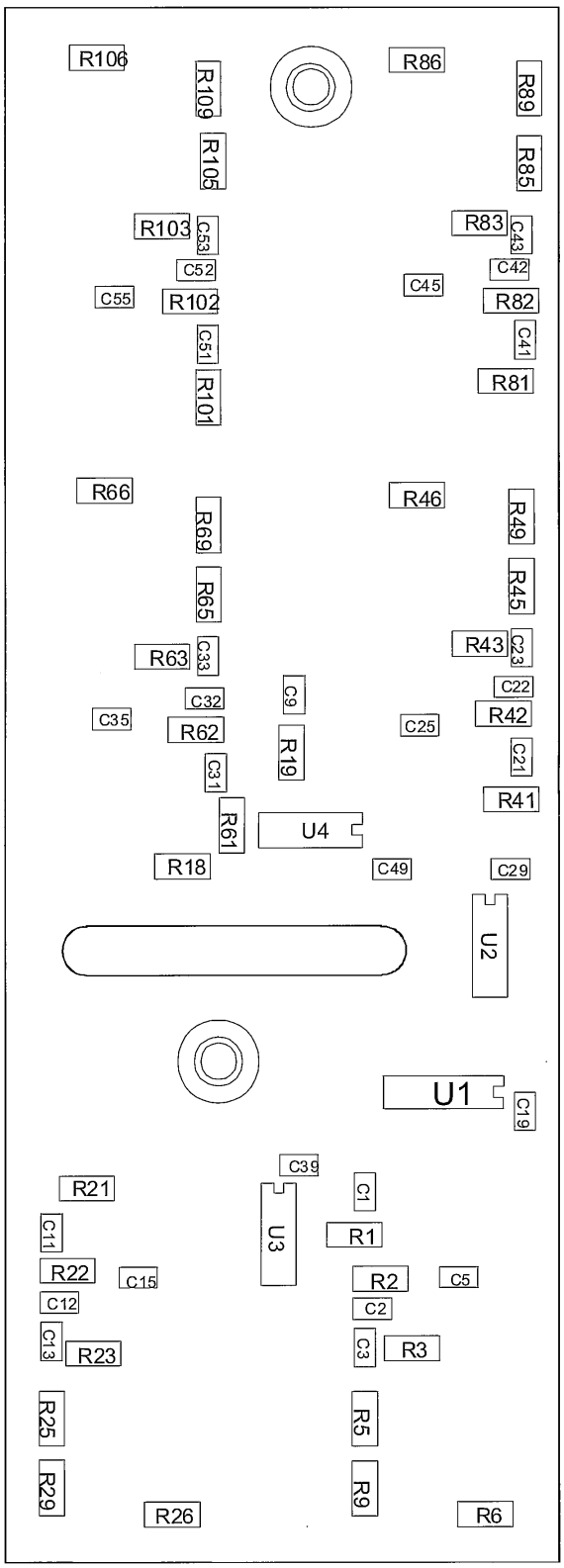
Pos	Description	Part Number	☆
J5	BUSHING MINICOAX FOR PC-B	5322 268 24116	S
J6	CONTACT PIN MINICOAX FOR PC-B	5322 268 14141	S
J6	BUSHING MINICOAX FOR PC-B	5322 268 24116	S
J7	CONTACT PIN MINICOAX FOR PC-B	5322 268 14141	S
J7	BUSHING MINICOAX FOR PC-B	5322 268 24116	S
J8	CONTACT PIN MINICOAX FOR PC-B	5322 268 14141	S
J8	BUSHING MINICOAX FOR PC-B	5322 268 24116	S
L1	CHOKE 470µH 10% BCL453232-471K	2422 536 00389	
L10	FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm	2422 549 43133	
L11	CHOKE 4.70uH 5% LQH1N4R7J	2422 535 94048	
L12	FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm	2422 549 43133	
L2	FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm	2422 549 43133	
L3	CHOKE 47µH 10% BCL322522-470K	2422 536 00388	
L4	FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm	2422 549 43133	
L5	CHOKE 10µH 10% BCL322522-100K	2422 536 00387	
L6	FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm	2422 549 43133	
L7	CHOKE 4.70µH 5% LQH1N4R7J	2422 535 94048	
L8	FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm	2422 549 43133	
L9	CHOKE 4.70µH 5% LQH1N4R7J	2422 535 94048	
Q1	TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W	9340 022 10701	
Q10	TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W	9340 022 10701	
Q11	TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W	9340 022 10701	
Q12	TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W	9340 022 10701	
Q2	TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W	9340 022 10701	
Q3	TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W	9340 022 10701	
Q4	TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W	9340 022 10701	
Q5	TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W	9340 022 10701	
Q6	TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W	9340 022 10701	
Q7	TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W	9340 022 10701	
Q8	TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W	9340 022 10701	
Q9	TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W	9340 022 10701	
R1	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R10	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R101	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R103	RESISTOR 3.30kohm 1% .125W 100PPM 1206	4822 051 53302	S
R104	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R105	RESISTOR 5.60kohm 1% .125W 100PPM 1206	4822 051 10562	S
R106	RESISTOR 1.50kohm 1% 0.125W 100PPM 1206	4822 051 51502	S
R107	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R108	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R109	RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206	4822 051 10109	S
R11	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R110	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R111	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R19	RESISTOR 120 ohm 1% 0.125W 100PPM 1206	4822 051 10121	S
R21	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S

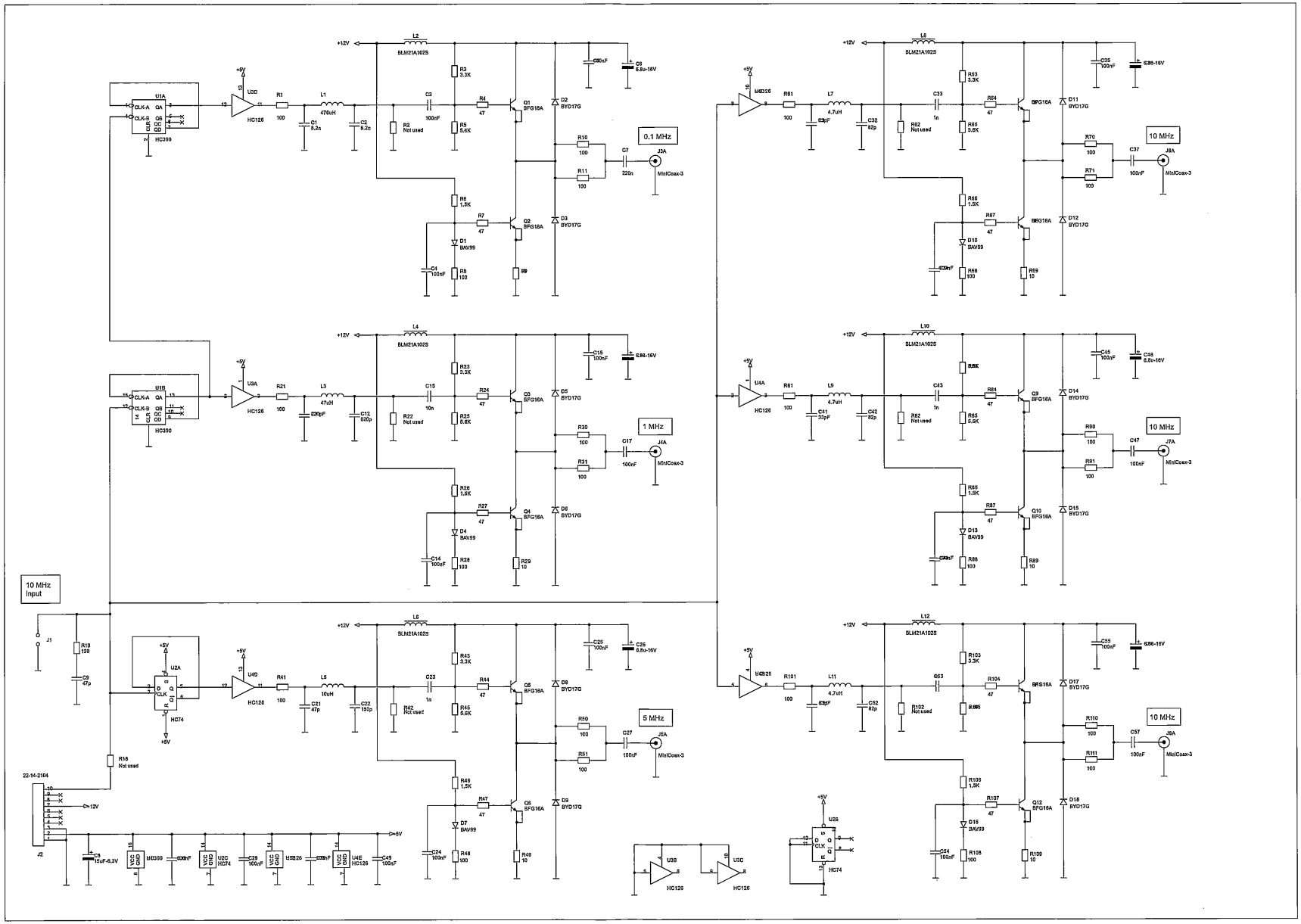
Pos	Description	Part Number	☆
R23	RESISTOR 3.30kohm 1% .125W 100PPM 1206	4822 051 53302	S
R24	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R25	RESISTOR 5.60kohm 1% .125W 100PPM 1206	4822 051 10562	S
R26	RESISTOR 1.50kohm 1% 0.125W 100PPM 1206	4822 051 51502	S
R27	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R28	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R29	RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206	4822 051 10109	S
R3	RESISTOR 3.30kohm 1% .125W 100PPM 1206	4822 051 53302	S
R30	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R31	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R4	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R41	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R43	RESISTOR 3.30kohm 1% .125W 100PPM 1206	4822 051 53302	S
R44	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R45	RESISTOR 5.60kohm 1% .125W 100PPM 1206	4822 051 10562	S
R46	RESISTOR 1.50kohm 1% 0.125W 100PPM 1206	4822 051 51502	S
R47	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R48	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R49	RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206	4822 051 10109	S
R5	RESISTOR 5.60kohm 1% .125W 100PPM 1206	4822 051 10562	S
R50	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R51	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R6	RESISTOR 1.50kohm 1% 0.125W 100PPM 1206	4822 051 51502	S
R61	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R63	RESISTOR 3.30kohm 1% .125W 100PPM 1206	4822 051 53302	S
R64	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R65	RESISTOR 5.60kohm 1% .125W 100PPM 1206	4822 051 10562	S
R66	RESISTOR 1.50kohm 1% 0.125W 100PPM 1206	4822 051 51502	S
R67	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R68	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R69	RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206	4822 051 10109	S
R7	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R70	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R71	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R8	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R81	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R83	RESISTOR 3.30kohm 1% .125W 100PPM 1206	4822 051 53302	S
R84	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R85	RESISTOR 5.60kohm 1% .125W 100PPM 1206	4822 051 10562	S
R86	RESISTOR 1.50kohm 1% 0.125W 100PPM 1206	4822 051 51502	S
R87	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R88	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R89	RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206	4822 051 10109	S
R9	RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206	4822 051 10109	S
R90	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R91	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
U1	IC-CMOS 74HC390 SMD SO16	9337 147 20701	
U2	IC PC74HC74T SO-14	5322 209 71589	S
U3	IC-CMOS PC74HC126T SMD SO14	5322 209 17393	S
U4	IC-CMOS PC74HC126T SMD SO14	5322 209 17393	S

TOP SIDE



BOTTOM SIDE




0.1 MHz
1 MHz
5 MHz
10 MHz
10 MHz
10 MHz
10 MHz Input
+12V
+5V
-5V
HC126
HC390
HC74
BFG16A
BYD17G
BAV99
MiniCoax-3
22-14-2104

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Chapter 10

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