Programmable Frequency Counter

PM6685 & PM6685R

Service Manual

FLUKE®

This is a complementary service manual covering instruments with manufacturing numbers exceeding 840684. The principal differences are to be found in Chapter 7 and in Chapter 8 due to a major redesign of the main PCB.

Do not dispose of the previous edition, identified by the part number, 4822 872 25012, and the publishing date, June 1996. You may have to refer to it for information on older instruments as well as options not mentioned here.

4822 872 20106
First Edition (May 2003)

Contents

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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 through your Fluke representative. See address at the end 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 (CENELEC) publication EN61010-1, and CSA 22.2 No. 1010-1, 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: Opening instrument covers or removing parts, except those to which access can be gained by hand, is likely to expose high voltages 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 protec- tive 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 nonvolatile 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 Fluke representative in your country.

Line Voltage

The instrument can be powered by any voltage between 90 and 265 V_{AC} without 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 Fluke representative. 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 3 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 recalibration 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.

Recommended Test Equipment

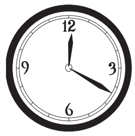
Type of instrument	Required Specifications	Suggested Equipment
LF Synthesizer	Square; Sine up to 10 MHz	
Power Splitter	50 Ω	PM9584/02
T-piece		
Termination	50 Ω	PM9585
Reference oscillator	10 MHz ±0.1 Hz for standard oscillator	Fluke counter with calibrated option PM9691
	10 MHz ±0.01 Hz for PM9691 & PM9692	Fluke PM6685R or PM6681R
	10 MHz ±0.0001 Hz for PM6685R	Fluke 910R or Cesium Standard
HF signal generator	0.5 GHz (no presc.) 3.3 GHz (option 10)	
Pulse Generator	125 MHz	
Oscilloscope with probes	350 MHz	
BNC cables	5 to 7 cables *	

Table 2-1 *Recommended Test Equipment.*

**) Two of the cables must have 10 ns difference in delay, for example: 5 ns and 15 ns.*

Preparations

Power up your instruments at least 20 minutes before beginning the tests 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 counter performs an automatic self-test of the following:

– Microprocessor

– RAM

– ROM

– Measuring circuits

– Display

If a GPIB interface is installed, the GPIB address is displayed.

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

– Turn on the counter and check that all segments light up on the display and that no error message appears.

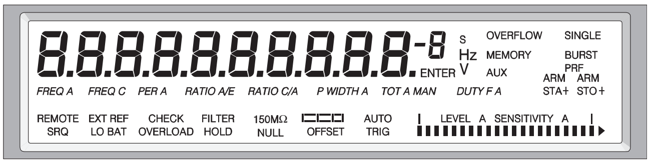


Fig. 2-1 *Text on the display.*

Internal Self-Tests

The different built-in test routines invoked by 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 **DATA ENTRY** up or down.

– Enter the test menu by pressing the **ENTER** key.

Selections for internal self-tests are:

1 TEST ALL (Test 2 to 5 in sequence)

2 TEST RO (ROM)

3 TEST RA (RAM)

4 TEST LOGIC (Measuring Logic)

5 TEST DISP (Display Test)

– Use **DATA ENTRY** up/down 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

The keyboard test verifies that the 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 mainly associated with the selected key.

Key(s)	Display	Note	Pass /Fail
STAND-BY	Display Off	Red LED beside the key On	
ON	Backlight on		
PRESET **ENTER**	DEFAULT? NO SIGNAL	Default setting	
EXT REF	EXT REF		
Input A			
FILTER	FILTER		
50 Ω	50 Ω		
__⌐‾| |‾|_| ‾‾|_| **(2 times)**	__|‾|		
SENS ← **(2 times)**	Bar graph: ▮▮▮▮▮▮▮▮		
SENS → **(2 times)**	Bar graph: ▮▮▮▮▮▮▮▮▮▮		
AUTO	AUTO TRIG		
Other			
PRESET **ENTER**	DEFAULT? NO SIGNAL	Default setting	
MEAS TIME	200^{-3} s		
DATA ENTRY ↑	500^{-3} s		
DATA ENTRY ↓	200^{-3} s		
ENTER	NO SIGNAL		
DISPLAY HOLD	HOLD		
DISPLAY HOLD			
SINGLE	SINGLE		
FUNCTION ←	DUTY F A		
FUNCTION ←	TOT A MAN		
FUNCTION →	DUTY F A		
FUNCTION →	FREQ A		
AUX MENU	RECALL		
MEAS RESTART	NO SIGNAL		
PRESET **ENTER**	DEFAULT? NO SIGNAL	Default setting	
CHECK	10.00000000^{6}Hz*	Start counting	
NULL	NULL		
NULL	10.00000000^{6}Hz*		
BLANK DIGITS **(3 times)**	10.00000_ _ _^{6}Hz*		
MENU	Displays all available functions, processes and input controls. Selected items are blinking.		

Table 2-2 *Keyboard Test.*

NOTE: For the instrument to respond correctly, this test must be carried out in sequence and you must start with the preset (power-on) setting.

* The LSD 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 counter in the default setting. Then confirm by pressing **ENTER**.

– Turn off AUTO.

– Select IMP A = 50 Ω and maximum sensitivity.

– 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 counter should display the correct frequency.

Frequency	Level			Pass/Fail
MHz	mV_{PP}	mV_{RMS}	dBm	Input A
1	30	10	–27	
25	30	10	–27	
50	30	10	–27	
150	60	20	–21	
200	90	30	–17	
250	150	50	-13	
300	150	50	-13	

Table 2-3 *Sensitivity of input A at various frequencies.*

Reference Oscillators

X-tal oscillators are affected by a number of external conditions, such as ambient temperature and supply voltage, but they are also affected by aging. Therefore, it is hard to give limits for the allowed frequency deviation. You must decide the limits depending on your application, and recalibrate the oscillator accordingly. See the Preventive Maintenance in the Repair chapter, Chapter 5.

Oscillator	Max. temperature dependence	Max. aging per month	Max. aging per year
Standard	±100 Hz	±5 Hz	±50 Hz
PM9691	±0.05 Hz	±0.1 Hz	±0.75 Hz
PM9692	±0.025 Hz	±0.03 Hz	±0.2
Rubidium	±0.003 Hz	±0.0005 Hz	±0.002 Hz

Table 2-4 *Deviation (for PM9691 and PM9692 after a warm-up period of 48 hours).*

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.

– Press the **PRESET** key, then press the **ENTER** key to set your counter in the Default setting.

– 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 a 30 minute warm up time. All deviations that can occur in a year are added together.

Oscillator	Frequency readout	Suitable reference	Pass /Fail
Standard	10.00000000 MHz ±120 Hz	PM9691	
PM9691	10.00000000 MHz ±1 Hz	PM6685R PM6681R	
PM9692	10.00000000 MHz ±0.25 Hz		

Table 2-5 *Acceptance test for oscillators.*

■ Acceptance Test, PM6685R

To fully test the accuracy of the PM6685R, a reference signal of extremely high stability is needed. Examples of such references are Cesium Atomic references, or transmitted signals from a nationally or internationally traceable source, like the GPS satellites.

Recommended Test Equipment

Type	Stability	Model
10 MHz reference	≤ $1x10^{-10}$	910R with satellite contact during the last 72 hours.

Test Procedure

– Connect the counter to the line power.

– Check that the UNLOCK indicator turns on, and then turns off again within 6 minutes after connecting line power.

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

– Select FREQUENCY A measurement.

– Select 2 s measuring time.

– Check that the displayed frequency is 10.00000000 MHz ±0.05 Hz ≤ 10 minutes after connection to line power.

Rear Input/Output

INT REF Output

– 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 sinusoidal and should be above 2.8 V_{PP}.

EXT REF Input

– Press the **PRESET** key, then press the **ENTER** key to set your counter in the Default setting.

– Apply 10 MHz sine to input A equipped with a T-piece and to Ext Ref input at the rear, terminated with 50 Ω. Amplitude on 10 MHz signal; 200 mV_{RMS}, (560 mV_{PP})

– Press the Ext Ref key.

– The display should show 10.00000000^{6} Hz ± 5 LSD.

EXT ARM INPUT

– Press the **PRESET** key, then press the **ENTER** key to set your counter in the Default setting.

– Select 50 Ω input impedance.

– Apply 10 MHz 500 mV_{RMS}, (1.4 V_{PP}) sine to input A

– The counter measures and displays 10 MHz.

– Press the **AUX MENU** key.

– Press the **DATA ENTRY UP/DOWN** keys until the display shows ‘Ar. Start’, confirm by pressing the **ENTER** key.

– Press **DATA ENTRY UP/DOWN** keys until the display shows ‘POS’, confirm by pressing the **ENTER** key.

– Press the **ENTER** key once more.

– The counter does not measure.

– Connect a pulse generator to Ext Arm input.

– Settings for pulse generator: single shot pulse, amplitude TTL = 0 - 2 V_{PP}, and duration = 10 ns.

– Apply one single pulse to Ext Arm input.

– The counter measures once and shows 10 MHz on the display.

Measuring Functions

Preparation for Check of Measuring Function is as follows:

– Connect a 10 MHz sine wave signal with 2.0 V_{PP} amplitude via a T-piece to Input A.

– Connect a cable from the T-piece to Input E (Ext Arm) at the rear.

– Select the measuring function as in the ‘Selected Function’ column and check that the counter performs the correct measurement by displaying the result as shown under the “Display” column in the following table.

Selected Function	Display	Pass/ Fail
PRESET ENTER	DEFAULT? 10 MHz 2)	
IMP A 50 Ω	10 MHz 2)	
Non AUTO	10 MHz 2)	
PER A	100 ns 2)	
RATIO A/E	1.0000000	
PWIDTH A	50 ns 1)	
TOT A MAN DISPLAY HOLD	Start counting	
DISPLAY HOLD	Stop counting	
DUTY FACT	0.500000 1)	
AUTO	0.500000 1)	

Table 2-6 *Measuring functions check.*

1) Value depends on the symmetry of the signal.

2) Exact value depends on the input signal.

Options

Prescaler

This extra HF input (PM9624) is easily recognized by its front panel connector (Input C, type N).

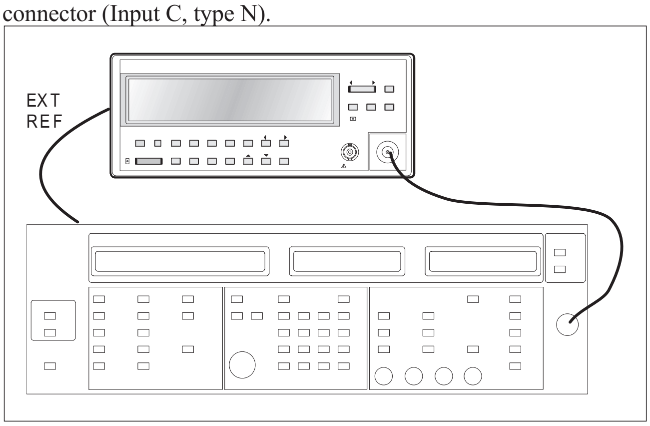


Fig 2-2 *Connect the output of the signal generator to the HF input of the counter.*

Required Test Equipment	Suggested Specification
HF signal generator	3.3 GHz

Table 2-8 *Test equipment for 3.0 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 *counter* after Preset.

– Function = FREQ C.

– EXT REF.

Generate a sine wave in accordance with the following table.

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

Frequency	Amplitude		Pass/Fail
MHz	mV_{RMS}	dBm	
100-300	20	–21	
-2500	10	–27	
-2700	20	–21	
-3000	100	–7	

Table 2-7 *Sensitivity of the PM9624 HF input.*

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Chapter 3

Disassembly

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

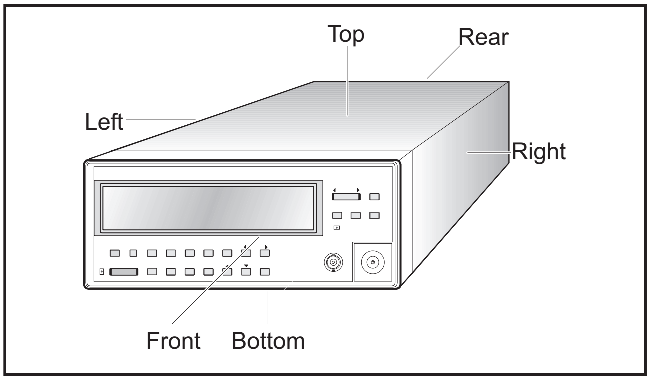

Fig. 3-1 *Designations used in this manual.*

The PM6685 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:

– PM9624 3.0 GHz HF input
– PM9691 High-Stability Oven Oscillator
– PM9692 Ultra-High-Stability Oven Oscillator
– PM9626B GPIB Interface

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

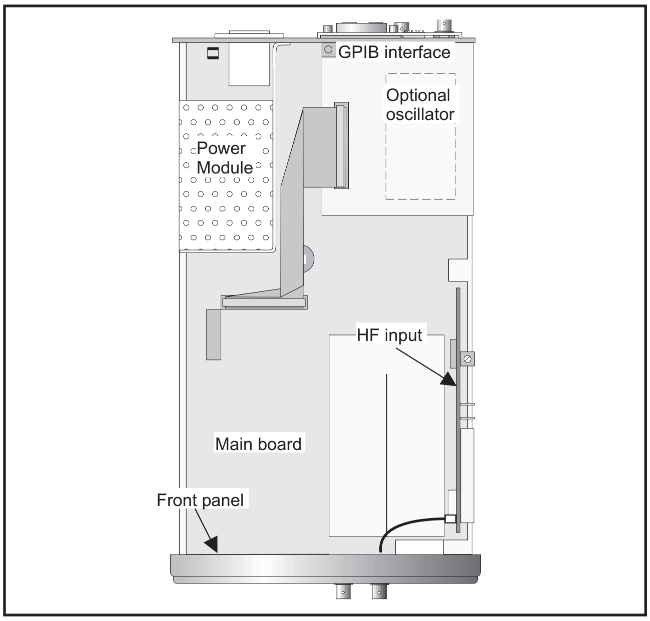

Fig. 3-2 *Location of the boards in the counter.*

Removing the Cover

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

WARNING: When you remove the cover you will expose high voltage 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 two screws **(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.

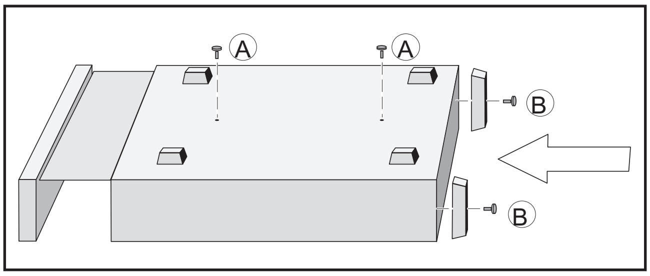

Fig. 3-3 *Remove the screws and push the counter out of the cover.*

Reinstalling the Cover

– Gently push the counter back into 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.

PM9624 (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)**.

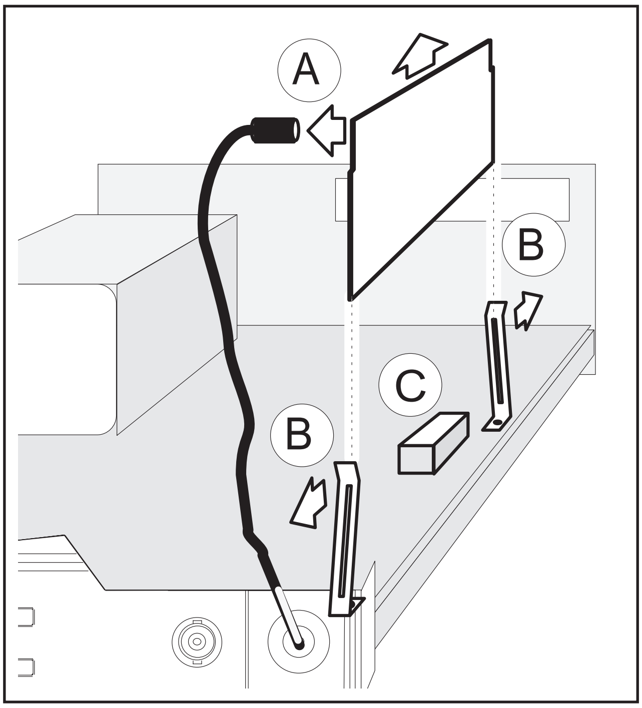

Fig. 3-6 *Removing the HF Input.*

PM9626 (GPIB Interface)

– Disconnect the power cable.

– Remove the cover from the counter.

– Loosen the two screws **(A)** holding the GPIB interface to the rear panel.

– Disconnect the interface cable from P103.

– Move the GPIB interface pca toward the front of the counter and lift the pca supports out from the “keyholes” **(B)** on the main PCA.

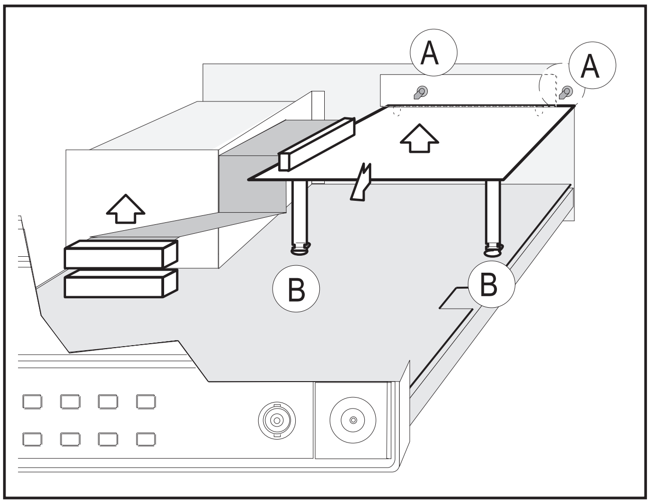

Fig. 3-4 *Loosen the two screws in the rear panel and disengage the board from the keyholes.*

PM9691 or PM9692 (Oven Oscillator)

– Disconnect the power cable.

– Remove the cover of the counter.

– Remove the two screws **(A)** holding the oscillator to the main pca from underneath.

– Press the clip **(B)** gently to the front of the counter and lift the oscillator straight up.

– Make sure that jumpers J14 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.

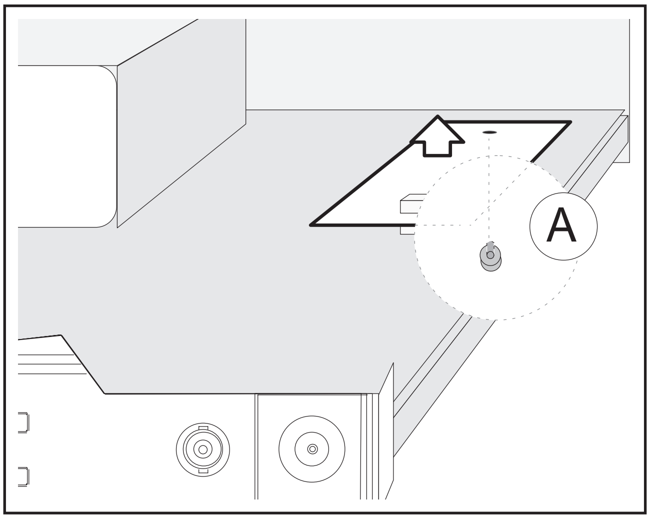

Fig. 3-5 *One of the two screws holding the oven oscillator in place.*

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Chapter 4

Circuit Descriptions

Block Diagram Description

General

The PM6685 Frequency Counter consists of three main units:

– Front unit
– Main board unit
– Rear panel unit

The following options can be added:

– GPIB interface including analog output (PM9626B)
– Prescalers 1.3 GHz (PM9621), 3.0 GHz (PM9624)
– Oven-controlled crystal oscillators (PM9691 or PM9692)
– Rack mount adapter (PM9622/02)
– Battery option (PM9623)

The chassis of the counter consists of a front piece molded in aluminum, an aluminum rear panel, and two profiled aluminum rods 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. It is connected to the main board unit with a flat cable, and the molded front unit is fixed to the two profiled aluminum rods with screws.

The main board unit consists of a PCB mounted on two profiled aluminum rods. Most functions, such as the following, are placed on the main board:

– Input amplifiers with trigger level circuits
– Power supply
– Measurement logic
– Microcomputer circuitry

Some outputs, such as the trigger levels and probe compensation view outputs are directly mounted on the main board.

The rear panel unit is of aluminum with a number of mounted connectors. Most of the connectors are soldered directly to the main board. The rear panel is fixed to the two profiled aluminum rods with screws.

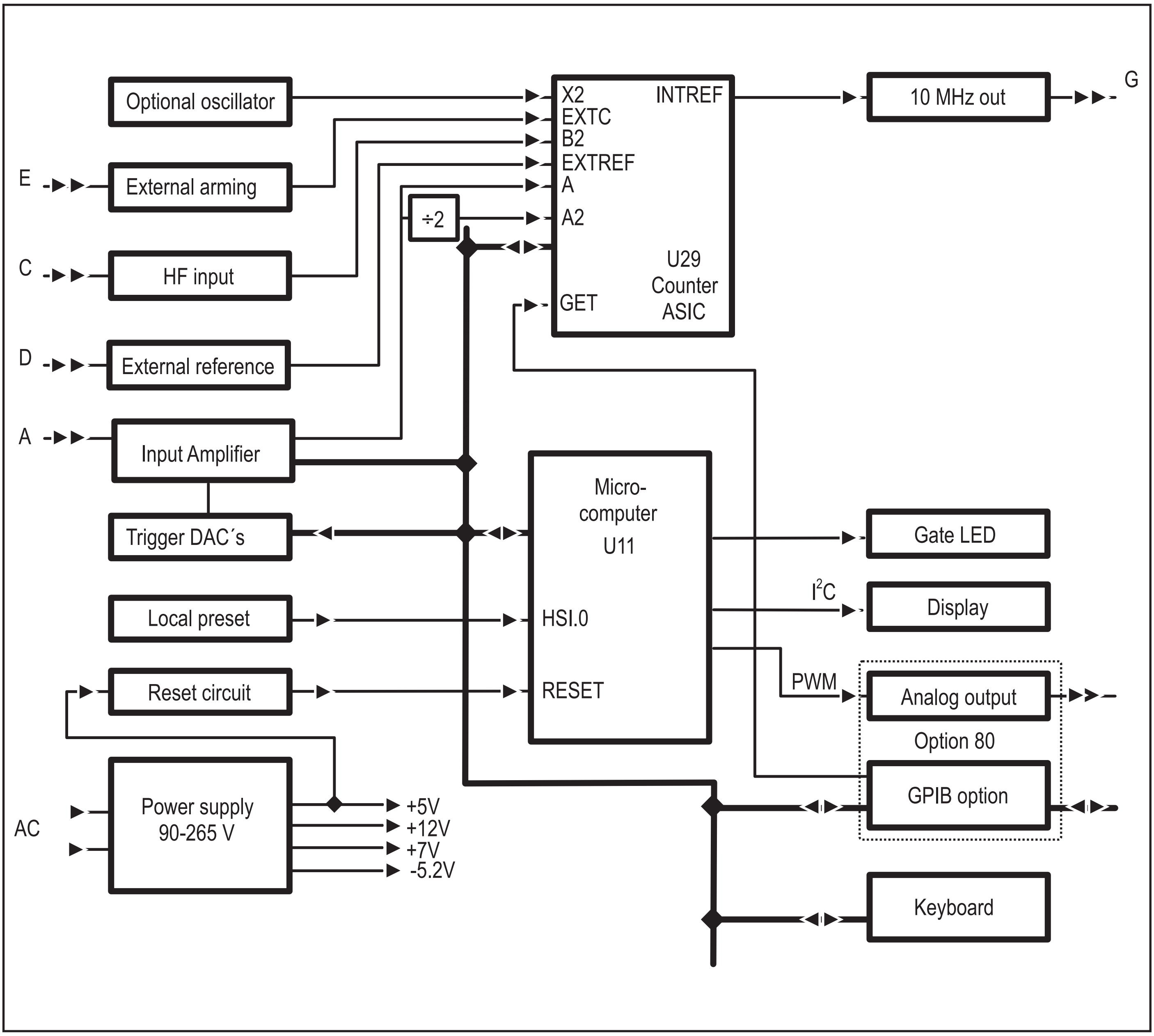

Fig. 4-1 *PM6685 block diagram.*

Hardware Functional Description

Front Unit

LCD Drivers

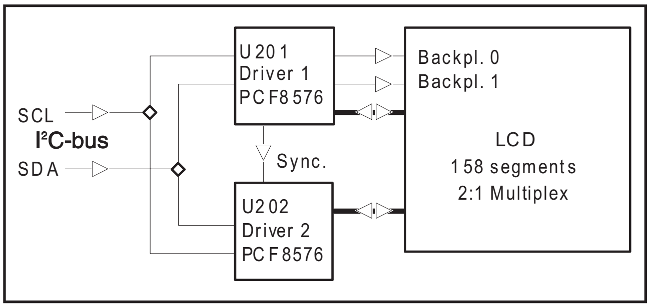

Fig. 4-2 *Front panel LCD drivers.*

An LCD and two LEDs are used as indicators. The LCD is used to show both the measurement result and the state indicators of the instrument setting. The LEDs show standby and gating.

The LCD has 158 segments that are multiplexed with a ratio of 2:1. Two parallel and synchronized LCD drivers (U201 and U202) are used. They are connected with a serial I^2C bus to the microcomputer on the main board. The clock frequency of the drivers is approximately 140 kHz, set by R201. The VLCD pin is connected to GND on the main board.

The LCD is provided with a backlight, an LED array integrated into one component. Its current consumption is set by the resistors R204-R207. The backlight dissipates approximately 1.5 W .

Keyboard

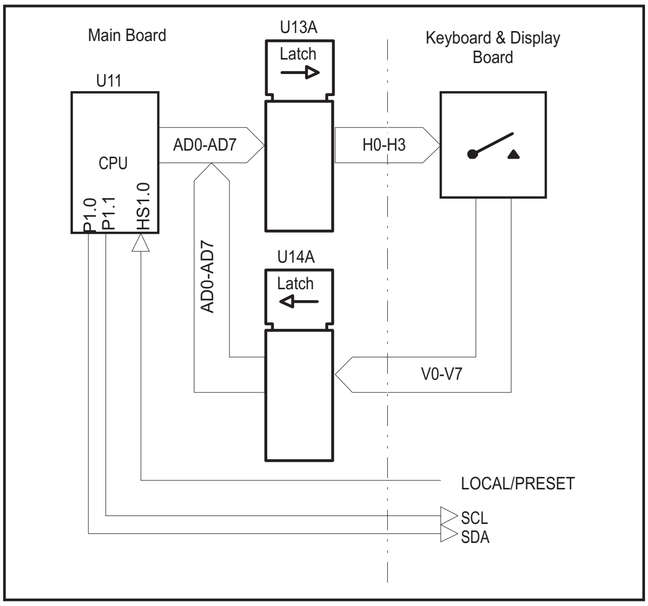

Fig. 3 *Keyboard scanning.*

The front panel pushbuttons are connected in a matrix. The scanning signals H0 to H3 come from the main board. If a push button is pressed and H0 to H3 is high, one of the output signals V0 to V7 will be high. The STAND-BY/ON and LOCAL-PRESET buttons are not part of the scanning but are connected directly to the main board.

The front unit is fixed to the main board unit with three screws. The electrical connection is made with a 40-lead flat cable to the main board.

Main Board

Introduction

Components not necessary for explaining the function are omitted from the figures in this chapter. For the complete set of components, see the circuit diagrams in Chapter 8, Drawings and Diagrams.

Input Amplifier

The input amplifier has 300 MHz bandwidth and is of the split-band type. It contains four main stages: the signal adaptation stage, the impedance converter stage, the comparator stage, and the buffer stage.

■ Signal Adaptation

This part of the amplifier contains:

– 50 Ω/1 MΩ impedance selector

– x1/x11 attenuator

– Voltage limiter

50 Ω / 1 MΩ Impedance Selector

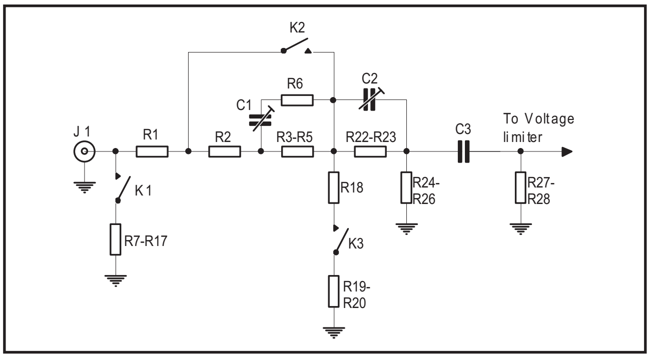

Fig. 4-4 *Impedance selector and 1X/11X attenuator.*

The 50 Ω or 1 MΩ impedance modes are selected by relay K1. 50 Ω is selected via the resistors R7 to R17, if the relay is closed. 1 MΩ is selected if the relay is open. Depending on selected attenuation, the 1 MΩ input impedance is determined by different combinations of resistors.

In *x1* attenuation mode (K2 is closed and K3 is open) the impedance is determined by resistor network R22 to R28.

In *x11* attenuation mode (K2 is open and K3 is closed) the same network as in the *x1* case is involved plus the resistors R3 to R5 and R18 to R20.

The input capacitance in parallel with 1 MΩ is 24 pF at *x1* attenuation and 12 pF at *x11* attenuation.

The series resistor R1 immediately after the selector serves both as current limiter together with the voltage limiter (see below) and as impedance matching resistor. The resistor also improves the Voltage-Standing-Wave-Ratio (VSWR) of the amplifier input.

x1/x11 Attenuator

The *x1* attenuator consists of a resistive low-frequency divider, which reduces the input signal by a factor of 2, and a capacitive high-frequency divider. The attenuator is formed by the resistors R22-R23 and R24-R26 in parallel with R27-R28. The capacitive part is formed by the variable capacitor C2 in parallel with R22-R23, and the parasitic capacitance across R24-R26.

The capacitive attenuator is adjusted via variable capacitor C2 to the same attenuation value as the resistive attenuator.

The *x11* attenuator also consists of a resistive low-frequency divider and a capacitive high-frequency divider. The resistive part is formed by R1-R5, and R18-R20 in parallel with 1 MΩ (the *x1* attenuator impedance). The capacitive divider is formed by the variable capacitor C1 and the parasitic capacitance at the node where R5, R18 and R22 meet.

Resistors R2 and R6 improve the frequency response.

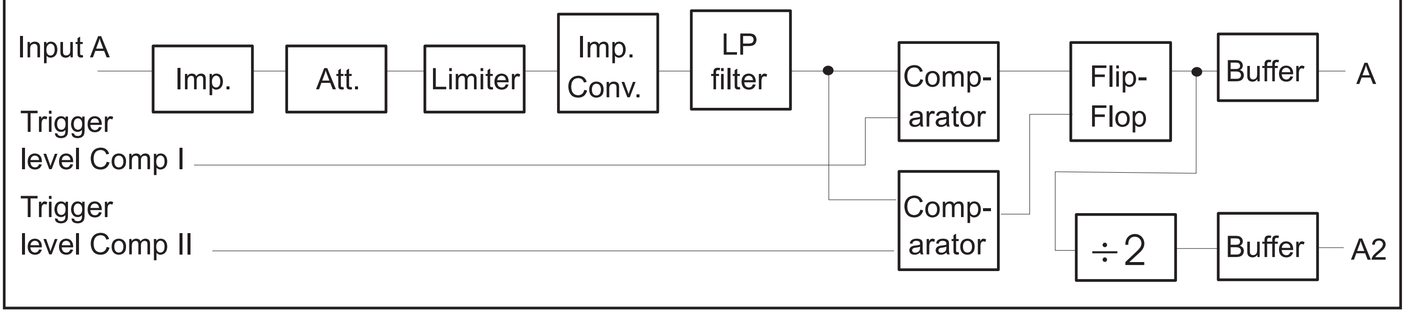

Fig. 4-5 *Input amplifier block diagram.*

Voltage limiter

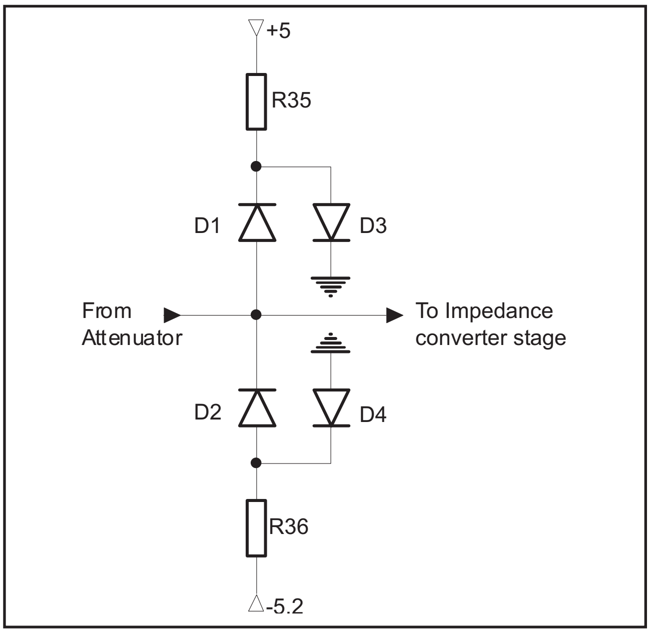

Fig. 4-6 *Voltage limiter.*

A voltage limiter that protects the impedance converter against overvoltage is placed between the attenuator and the impedance converter. The voltage limiter consists of resistor R35 and the diodes D1 and D3 to clamp positive voltage and resistor R36 plus the diodes D2 and D4 to clamp negative voltage. The clamp voltage is approximately ±2.1 V for low frequency signals. At high frequency the clamp voltage rises to approximately ±2.3 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 good frequency response over a wide range. This means that the high-frequency contents of the signal are fed to a high-impedance AC-coupled FET transistor stage Q1. The low-frequency contents are fed to a DC-coupled operational amplifier stage with negative feedback from the output of the converter stage buffer. The low-frequency path handles frequencies up to approximately 5 kHz.

The high-frequency signal is fed to the gate of Q1. The high impedance at the gate is converted to a low impedance at the source. The source is connected to the base of HF transistor Q2, the summing point for the two signal paths.

To make the FET work well in its active region within the whole dynamic range, the FET drain is supplied with +7 V via resistor R42.

The low-frequency signal is divided by the two resistors R27 and R28 before it is coupled to the input pin #2 of the operational amplifier U1. The resistors R37 and R38 at the operational amplifier output pin #6 center the output swing, and capacitor C6 stabilizes the operational amplifier stage.

The low-frequency path goes from the operational amplifier to the base of transistor Q3, the collector of which is connected to the base

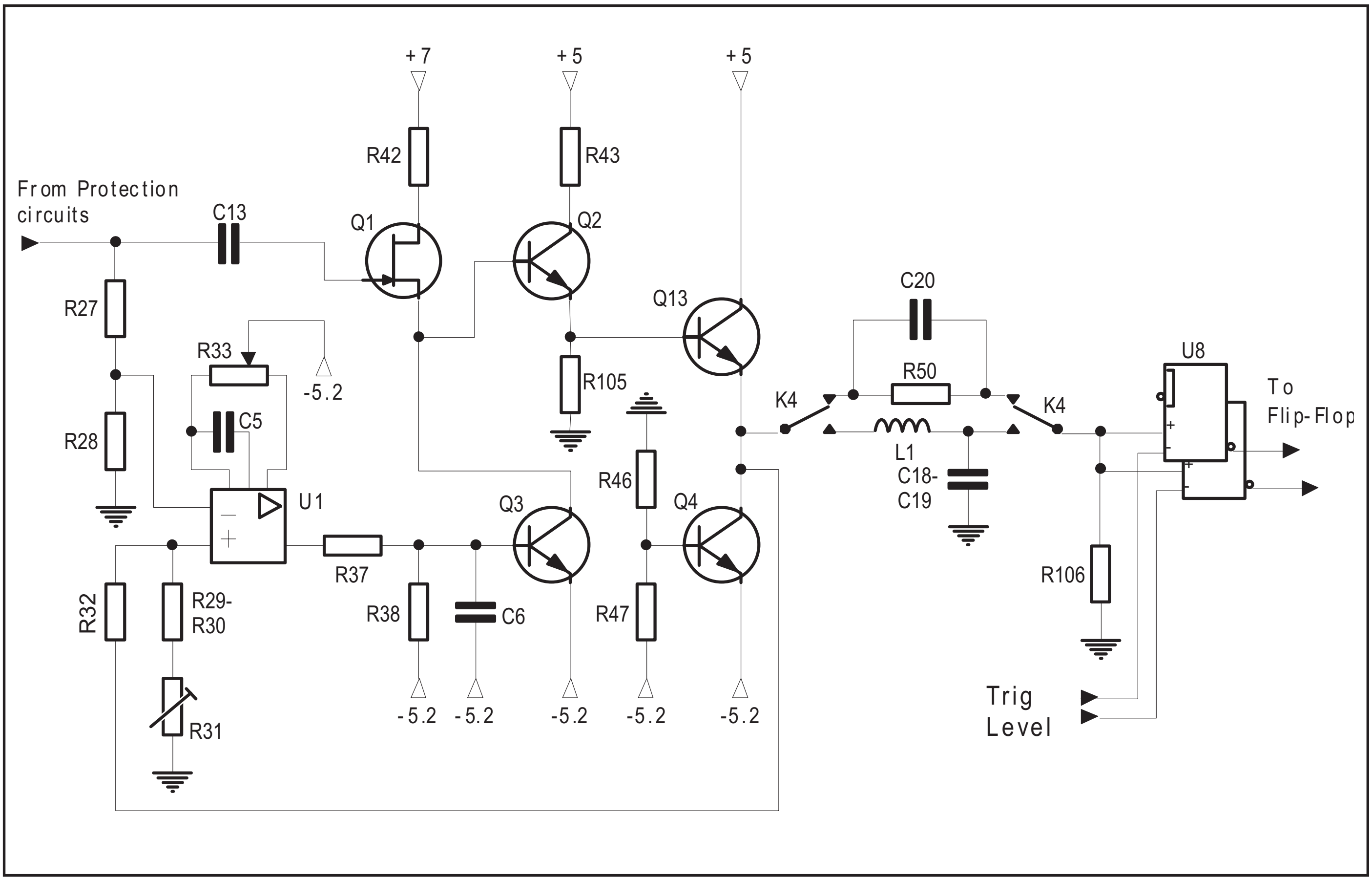

Fig. 4-7 *Impedance converter.*

of transistor Q2. This point is common to the high and low frequency paths.

A buffer amplifier with high driving capacity is used to get a linear output in the 100 Ω load resistor R106 over a swing of 2 V. This amplifier consists of a driver stage Q2, an output stage Q13, and a current generator Q4.

From the output of this second amplifier stage, the signal is fed back to the op amp pin 3 via the divider chain R29 to R32. The trimmer potentiometer R31 sets the gain of the low-frequency path equal to the high-frequency gain of about 0.9. Capacitor C5 is connected to operational amplifier pins #1 and #8 to achieve stable operation. The trimmer potentiometer R33 between pins #1 and #5 on the operational amplifier is used for adjusting the offset voltage of the operational amplifier.

The channel A filter connected to the output of the second amplifier stage is a 100 kHz low-pass LC filter. It consists of the coil L1 and the two capacitors C18 and C19 in parallel. The filter is controlled by the relay K4. The filter output is connected to the input of the comparator stage.

■ Comparator Stage

The comparator stage converts the analog signal from the impedance converter stage to a square wave. This circuit consists mainly of the high-speed integrated comparators U8A and U8B plus a separate trigger level circuit connected to the comparators at pins 9 and 13 via resistors R87 and R88.

The trigger level circuits, which are described later, generate a DC level in the range of approximately æ1.6 V. This covers a dynamic range of 6.4 V since the input signal is divided by a factor of 2 before it reaches the comparator.

The counter is provided with adjustable hysteresis, i.e., it is controllable via the front panel or GPIB. The circuitry for setting the hysteresis consists of the resistor network R91 to R96, supplied with +5 V and –5.2 V. It is connected to the latch enable inputs of the comparator, pin 5 and 7 for Comparator I and pin 17 and 15 for Comparator II.

The input signal is fed to both comparators, the outputs of which are used for setting/resetting the Flip-Flop U9.

■ Buffer Stage

Before the signal is fed further into the ASIC U29, it has to be level-shifted by a buffer stage. The negative ECL logic levels (~ –0.9 V to ~ –1.7 V) from U9 pins 17 and 18, are converted to a

single-ended signal with CMOS logic levels (~ 5 V to ~ 0 V).

The buffer is a differential amplifier consisting of the two transistors Q32 and Q33 whose bases are fed differentially from the two comparator outputs. Resistor R304 serves as a current generator that is switched alternately to the two collector resistors R296 and R297.

Trigger Level Circuits

The trigger level circuits generate the trigger voltage levels to the input comparators. The trigger level range is –3.2 V to + 3.2 V with a maximum resolution of 0.6 mV. The input amplifier attenuation is

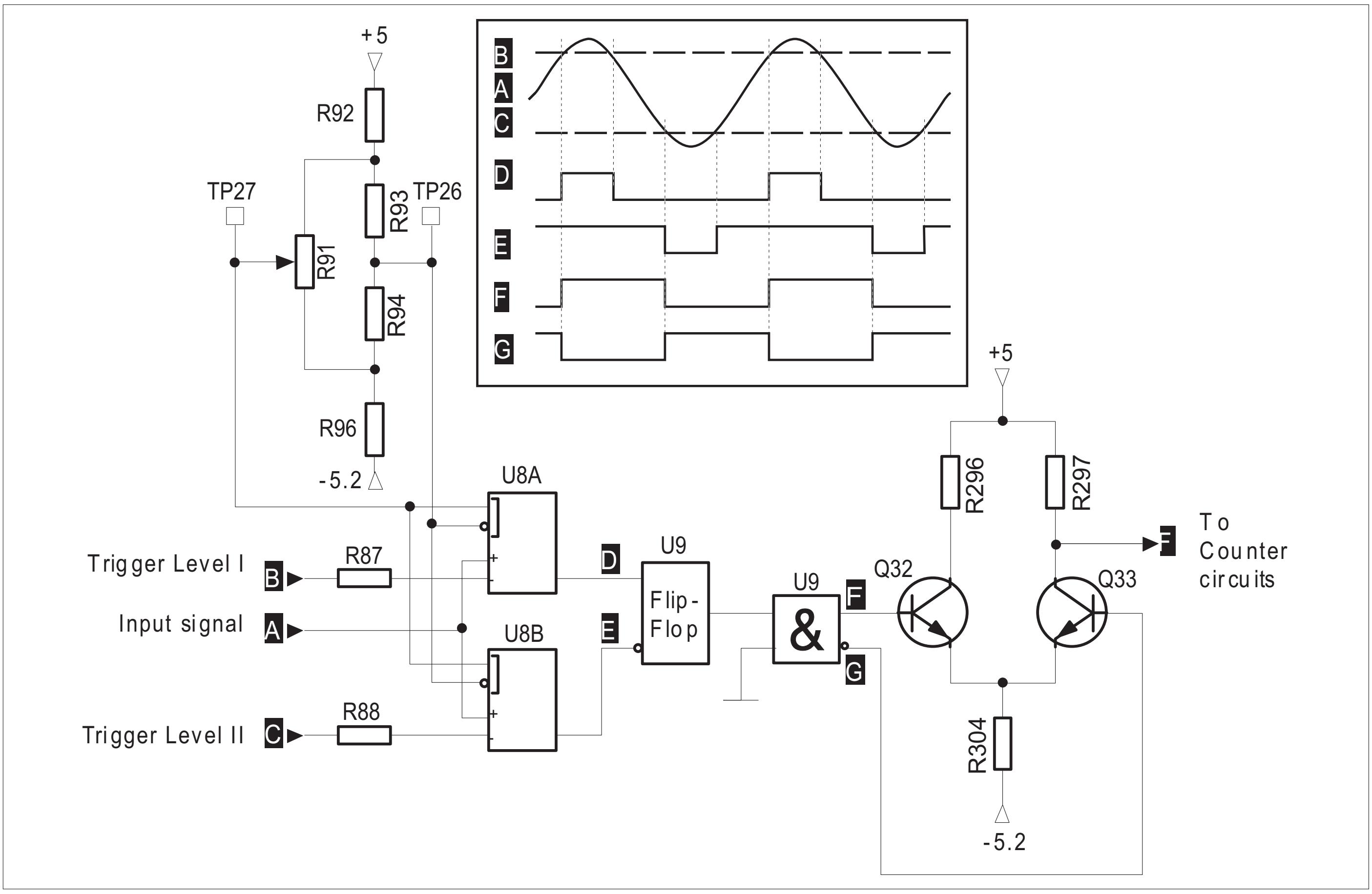

Fig. 4-8 *Comparator flip-flop and buffer stages.*

approximately 2 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 –1.6 V to +1.6 V with a resolution of maximum 0.3 mV. A dual 8-bit DAC is used. The DACs only generate voltages between 0 and +1.6 V, but by using a X2 amplifier and an offset shift of 50%, the voltage range of –1.6 V to +1.6 V is achieved. The supply voltages to the trigger level circuits are filtered by R and C to prevent noise originating in the digital circuitry from influencing the trigger levels. The ground plane under the trigger level circuits is separated from the rest of the ground plane, and the planes are connected only at the front of the counter.

The trigger level circuits consist of the following:

- Resistor network R57 to R68 for generating the reference voltages 0.04 V, 0.22 V, 0.59 V, and 1.6 V.
- Three multiplexers (U3) to select one of the levels. With this arrangement there is a total trigger level range of –1.6 V to +1.6 V.
- A double DAC (U4).
- Two current-to-voltage converters U6. These circuits convert the current at the IOUT pins of the DACs to a voltage. This signal has a range of 0 V to approximately 1.6 V.
- Two amplifiers, U7, with an amplification of X2, to generate a signal with a range of 0 V to 3.2 V. Resistors R69 and R70 set the reference voltage to the amplifier to get the 50 % offset shift. To get exact voltages, 0.5 % precision resistors are used: R73-R75, R78-R79 and R80-R82, R85-R86.
- The zero adjust of the trigger levels is done with trimmer potentiometers R69 and R70 connected to the amplifiers in U7.
- Two low-pass filters R87-C29 and R88-C30.

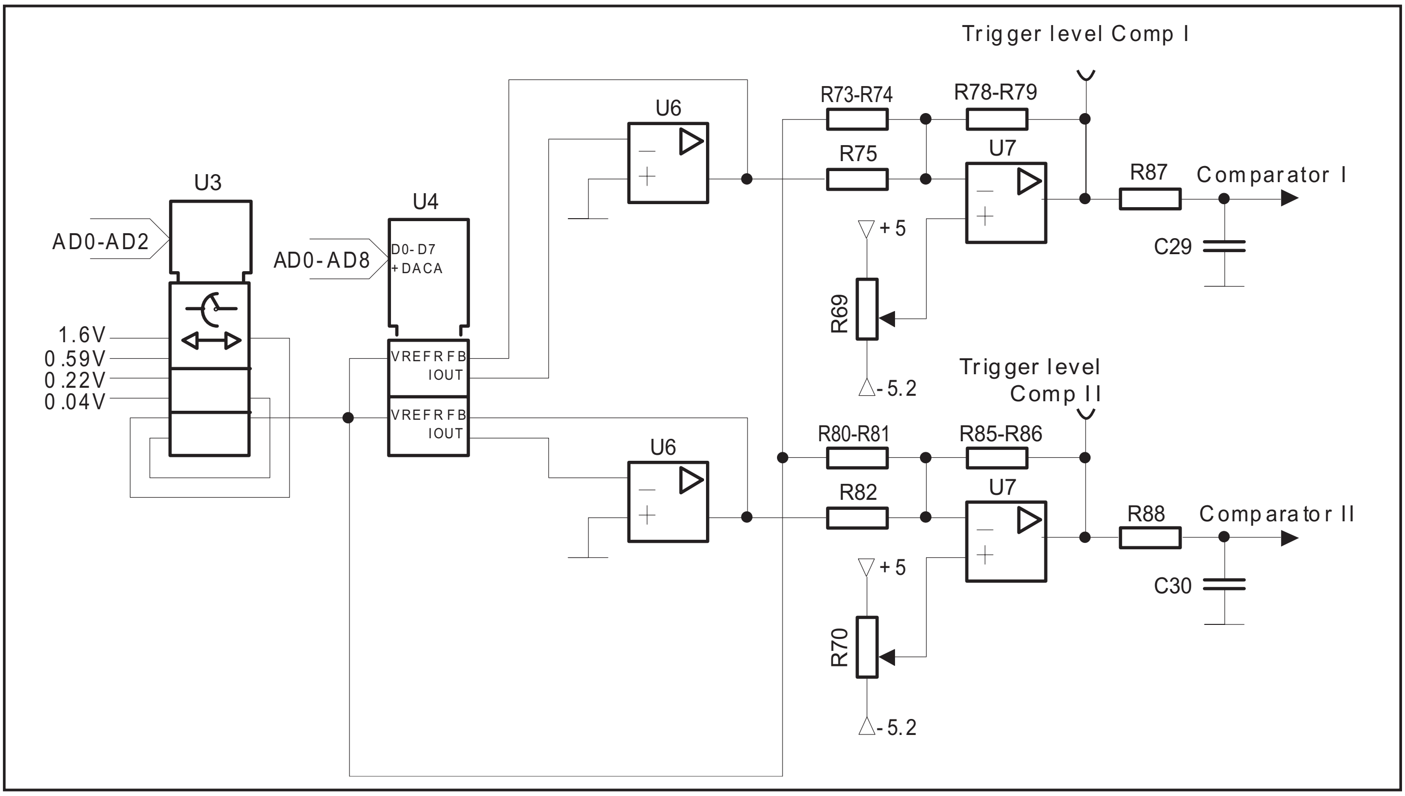

Fig. 4-9 *Trigger level circuits.*

Power Supply

■ General survey

The power supply generates four regulated DC supply voltages to the counter, as well as some other supply voltages for special purposes. The power supply block also contains the ON/STANDBY logic.

The main building block of the power supply is a primary switch mode power module (U39). The line power AC voltage (90 V to 265 V) is rectified to a DC voltage before it is fed to the power module.

After a line power filter in the power inlet, a fuse of 1.6 AT 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 inrush current to the capacitors at the connection of the power cord, an NTC resistor (R148) is used. The resistance is 15 Ω when the resistor is cold but decreases to a few ohms as it is warmed up by the steady-state current.

The AC voltage is rectified in the bridge rectifier D9 and filtered in C64. C65 suppresses noise from D9. L6 and C82-C83 serve as a filter at the input of U39.

All inputs and outputs of the power module have HF chokes. The module is mounted with distance washers on the main board.

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 approximately +18 V, and the output marked –7 will be approximately –8 V. The outputs are filtered; HF is filtered by C70-C73, and LF is filtered by L7-L9 and C74-C76.

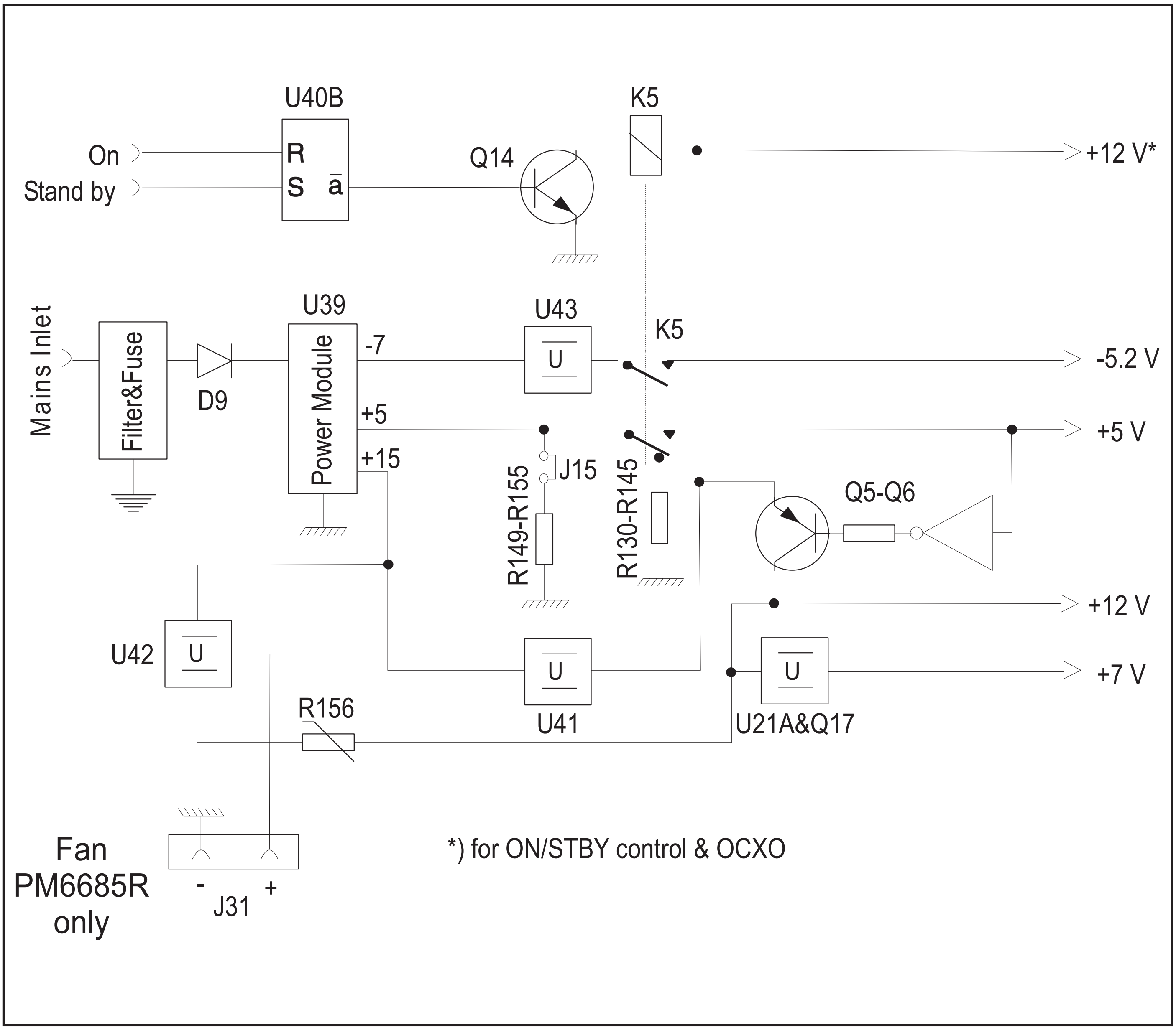

Fig. 4-10 *Power Supply.*

■ Function

The three DC voltages from the power module are used for generating the following four supply voltages in the counter:

+5 V

Regulated +5 V from the power module is used directly.

–5.2 V

–7 V is used, with regulator U43.

+12 V

+15 V is used, with regulator U41.

+7 V

Stabilized +12 V is used, with regulator U21A and Q17.

The following supply voltage is used for a special purpose:

*+12 V**

This voltage comes directly from the +12 V regulator U41and will be present as soon as the power cord is connected, regardless of the position of the ON/STANDBY switch. It is used for the ON/STANDBY control logic and for supplying an optional OCXO in STANDBY to avoid the long warm-up time otherwise needed to obtain maximum accuracy.

At stand-by, the four main supply voltages are switched off, but as described above, some parts of the instrument should not be diconnected. Therefore the power module will never be switched off. The PM6685 has consequently only a secondary power switch.

A relay (K5) disconnects the load on the +5 V and –5.2 V at stand-by. Because the power module must always have a load on the regulated voltage, seven bleeder resistors R149-R155 are always connected to +5 V via J15. At stand-by the counter only needs +15 V, so a dummy load consisting of R130-R145 is connected to the power module by means of the relay K5 in order to stabilize the operation of the switchmode converter.

+5 V controls the switching on/off of +12 V and +7 V. When +5 V is on, Q6 and Q5 will conduct, i.e. +12 V will be on. If there is no +5 V, Q6 and Q5 will be off, thus blocking the +12 V.

The ON/STANDBY logic controls relay K5, which operates as described above. It is also possible to open the relay by changing the position of J16.

The ON/STANDBY logic consists of the RS (set-reset) flip-flop U40B that is controlled by the ON/STANDBY button on the front panel. Pressing STANDBY will apply a high voltage (+12 V) to the set input. The inverting output of the flip-flop will be low, disconnecting K5 via Q14. Pressing ON will give a high voltage (+12 V) on the reset input. The inverting output of the flip-flop will be high, engaging K5. Inserting the power cord into the power inlet will cause a pulse on the reset input, via C35. The microcomputer can disable the ON/STAND-BY button via Q12 and Q7. This is done in remote mode and during RAM-testing. A high level on the base of Q12 enables STAND-BY, a low level disables it.

The STAND-BY indicator on the front panel is controlled by the +5 V via Q16. +5 V *off* lights the STAND-BY LED that is fed by the uninterruptible +12 V*.

+5 V also indirectly controls the fan in the PM6685R. It is a 12 V DC fan that operates only if +12 V is on. An NTC resistor, serving as a temperature sensor, controls the speed by applying a variable reference voltage to the fan voltage regulator U42.

Counter ASIC

The main part of the counting logic is integrated in a CMOS ASIC specially designed for the Fluke MultiFunction Counter series. There are also analog blocks included in the 100 pin QPF package.

MUX

The MUX block is a switchboard for incoming and internal signals involved in the measuring process. Some signals are divided by 2 to make it possible to measure higher frequencies. The trigger slope is controlled by the MUX block as well. A trigger edge detector senses the presence or absence of comparator pulses and controls the trigger level DAC's in the TLDAC block. These functional units form an essential part of the Auto Trigger System.

OSC

The oscillator block generates, selects, and distributes the reference clock for the circuit. The active semiconductors of the standard oscillator are included in this block. The crystal is connected to pins X1 and X2. A TCXO or OCXO is connected to X2 only. An external reference clock is connected to EXTREF. The PWM signal generated at OTRIM controls the frequency of the reference oscillator after external integration.

PG

A built-in pulse generator having the 10 MHz clock as a reference can generate pulses with controllable duration and repetition rate at the OUTPUT connector. The level is fixed TTL.

RTC

A real time clock not used at present.

TLDAC

This block contains two 10-bit DAC's generating the trigger levels for the input comparators, VOUTA for channel A and VOUTB for channel B. An external reference voltage is connected to V+REFA and V+REFB.

HO

The Hold Off block can manipulate the internal measuring signal X in several ways. One operating mode simulates a low pass filter (normal hold off), another mode is used in burst measurements.

The following blocks (SYNC, STST, CNTS and MCTRL) form the actual measuring logic in the ASIC. Three types of measurements can be made in this MEAS block:

Continuous measurements (frequency, ratio and period average). Not used at present.

Controlled measurements (time interval, period single, pulse width, frequency, totalize gated, totalize start-stop, and ratio).

Totalize manual.

SYNC

The SYNC block synchronizes the actual measurement with certain internal or external events like measuring time and arming signals.

STST

The start and/or the stop of the measurements are controlled by this block. External events can be used to define the exact moments.

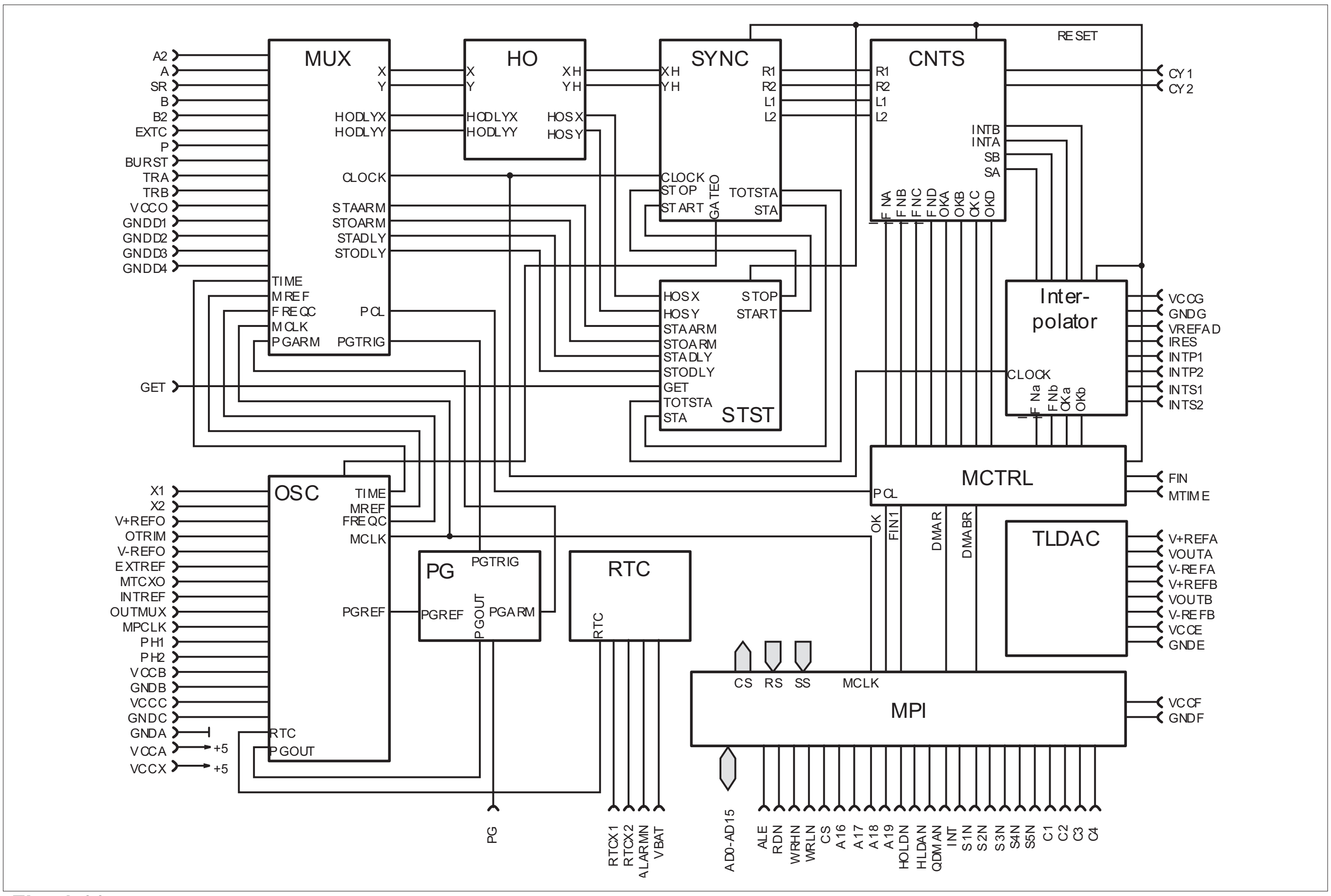

Fig. 4-11 *Counter ASIC, block diagram.*

CNTS

Two 32-bit binary counters count external events or keep track of the time.

Interpolator

This block is not used at present.

MCTRL

The different events in the measurement cycle of the ASIC are timed by this block.

MPI

This is the microprocessor interface block. The bus width is 16 bits, AD0 to AD15. Interrupts to the microprocessor are generated at INT.

GET

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

■ External Interpolator

The X-POLATOR unit is connected directly to the internal interpolator in the ASIC. It is used for increasing the time resolution beyond the limits set by the reference clock period of 100 ns. An error pulse is generated in the SYNC block. Its width is determined by the difference between an external event on an input channel and the next clock pulse. This pulse controls a current generator charging a capacitor. When the pulse has expired the voltage across the capacitor is A/D converted and the value is added to the result. There are two interpolators, one for the start event and one for the stop event. They are calibrated over the possible error pulse range to allow for any aberrations from the theoretical linear behavior.

Oscillator Circuits

■ CPU Oscillator

The microcontroller U11 is clocked at 12 MHz. The crystal B1 is connected to the XTAL inputs of the microcontroller.

■ Reference Oscillators

A 10 MHz crystal oscillator is used as the reference for the measuring logic. If a stable external 10 MHz reference is available, it can be connected to REF IN on the rear panel and selected by means of the EXT REF button on the front panel.

In addition to the standard crystal oscillator there are two optional oven-controlled crystal oscillators (OCXO) to choose from.

Standard

The uncompensated standard oscillator consists of the crystal B2, C109, C113-C115, R209 and R211. C115 is used for manual adjustment of the frequency when the calibration tolerance has been exceeded. The active circuitry is built into the ASIC U29 and is accessible via the pins marked X1 and X2.

OCXO

If one of the OCXOs is mounted, the standard oscillator has to be inactivated by moving the jumpers J23 and J25 to their alternative position. These oscillators are connected to J24 and are self-contained units with facilities for coarse and fine adjustment. They are fixed to the main PCB with two screws. The output signal is AC-coupled to the X2 pin on U29 via C107.

External

This input consists of an AC-coupled line receiver with Schmitt trigger function (U28) and is protected against excessive voltage excursions by a resistor-diode network. The output signal from U28 has CMOS logic levels and is connected to the EXTREF pin on the counter ASIC U29.

Logic

■ Microcomputer Circuits

Microcontroller

The microcomputer circuitry consists mainly of the microcontroller U11, an Intel 16-bit CMOS 80C196, RAM (U22A), and EPROM (U23A). The microcontroller is clocked at 12MHz. The data and address lines AD0 to AD15 are shared by means of multiplexing. Therefore the addresses are stored in the latches U16A and U17A. The ALE signal (Address Latch Enable) enables the latches.

UVEPROM

The main program is stored in U23A that is mounted in an IC socket, making it easy to update and customize the instrument firmware by changing the EPROM.

EEPROM

Front panel settings, GPIB address and certain other data that are not changed frequently, e.g. information in the Protected User Data Area, are stored in U12A which does not need battery backup.

Reset Circuit

A special reset circuit, the power supply supervisor U10, is included in the design. If the +5 V supply line becomes lower than 4.5 V, the reset output pin 5 goes low and the microcontroller will start over. The length of the reset pulse is set by C88; 2.2 µF gives a pulse of approximately 30 ms. U10 also controls the reset pulse during power-up so that the microcontroller will be initiated correctly.

■ Keyboard Scanning

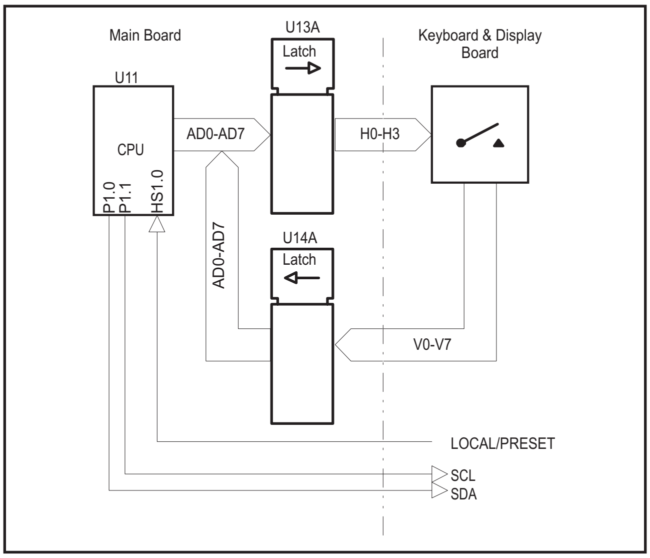

Fig. 4-13 *Keyboard scanning.*

The keyboard scanning is done in two modes. The first mode is active as long as no button has been detected as depressed. Then all outputs of U13A are set high, and the latch U14A is read. If no button has been depressed, all outputs are low. This check is done at every timer interrupt in the microcontroller, every 25 ms. If a button is depressed, one of the output bits is high. When this event is detected, mode two is entered. The outputs of U13A must be set high one after the other to find the specific button. When found, only this button will be checked, so other simultaneously depressed buttons will not be recognized. The depressed button must stay down for several timer interrupts before action is taken. After the button has been recognized, the timer interrupt SW will be waiting for the button to be released. The button must be released for several timer interrupts before the keyboard scanning returns to mode 1. Then the search for other activated buttons can be resumed.

The following three buttons are not scanned in this way:

– The ON button is connected to the ON/STANDBY logic in the power supply.

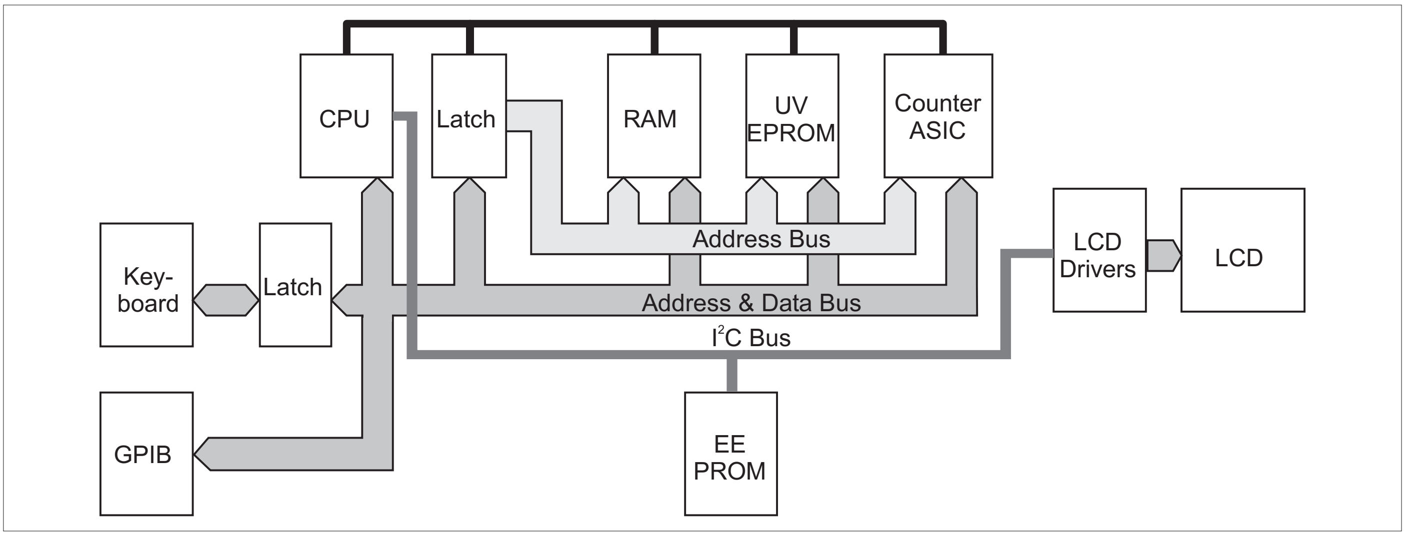

Fig. 4-12 *Microcomputer circuits, block diagram.*

– The STAND-BY button is connected to the ON/STANDBY logic in the power supply.

– The LOCAL/PRESET button is connected directly to input pin 24 on the microcontroller U11. Pressing this button sends an interrupt to a special handler in the SW.

Rear Panel Unit

The rear panel contains the following connectors

INPUTS:

– External reference input D - REF IN (BNC)

– External arming input E - EXT ARM (BNC)

– Power supply inlet including EMI filter

OUTPUTS:

– Internal reference output G - 10 MHz OUT (BNC)

If a GPIB interface is installed in the device, it is mounted on the rear panel and connected to the main board with a flat cable.

Besides the normal standard GPIB connector, this optional unit also has a BNC connector capable of outputting an analog representation of any three consecutive digits on the display.

There is also a 6 SPST DIP switch on this unit for setting the default GPIB address.

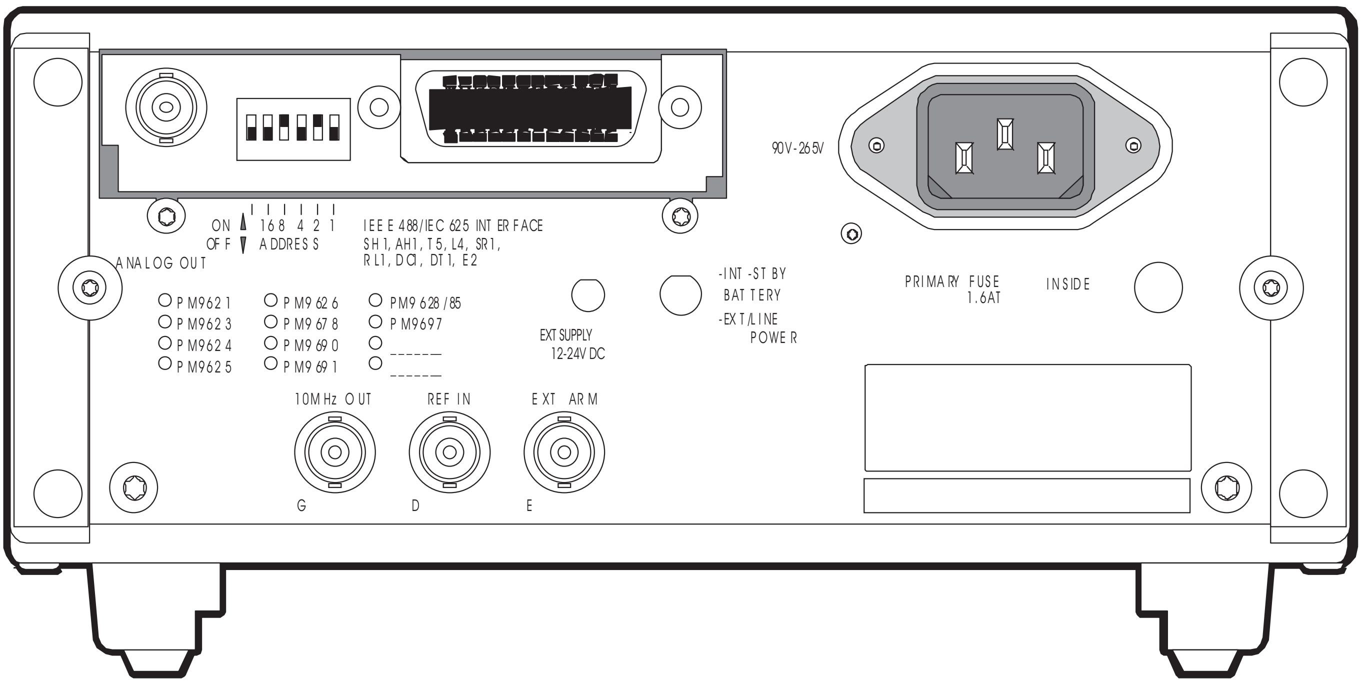

Fig. 4-14 *Rear panel.*

Optional Units

GPIB Interface Including Analog Output

■ GPIB, PM9626B

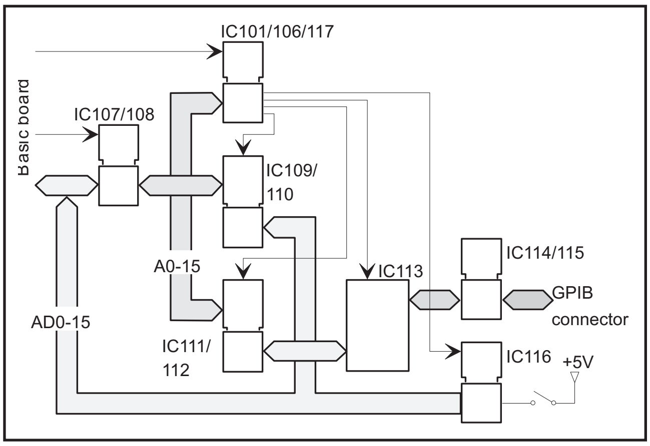

Fig. 4-15 *GPIB interface.*

The GPIB interface controls the communication between the internal microprocessor and the external GPIB bus. A 32K extension of the ROM and RAM is placed on the interface board. An analog output is also included. The PCB is connected to J18 on the main board with a ribbon cable and fixed to the rear panel with two screws. Two metal studs at the rear edge of the PCB are inserted in slots on the main board in order to relieve mechanical stress.

The GPIB control circuit, IC113, communicates with the external GPIB bus via the bidirectional bus drivers IC114 and IC115. IC113 is controlled from the microprocessor by writing and reading in the internal control registers. If IC113 has a message for the microprocessor, it uses the GPIB interrupt signal. The address switch setting is read by the microprocessor via IC116.

A 32K extension of both ROM (IC109 and IC110) and RAM (IC111 and IC112) is placed on the interface board. The circuit board is prepared for a 16-bit extension, but only 8 bits are used. IC110 (ROM), IC112 (RAM) and R118 are not mounted. IC107, IC108 are address latches and IC101, IC106 and IC117 use the latched address to generate chip select and chip enable signals for internal use on the GPIB board.

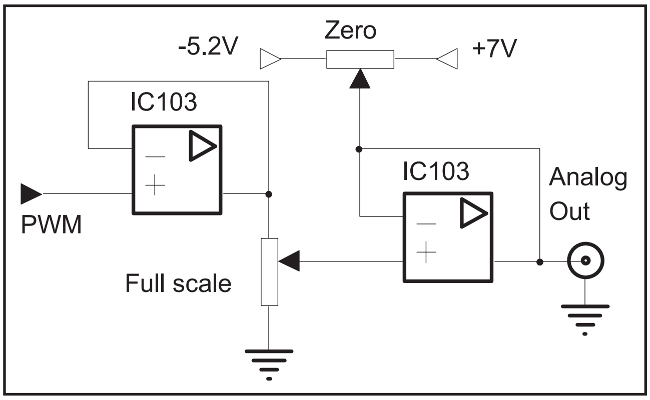

Fig. 4-16 *Analog output.*

■ Analog Out

The result on the display can be converted to an analog signal by means of a pulse-width-modulated (PWM) signal from the microprocessor. The signal is filtered, attenuated, offset-adjusted, integrated and buffered by IC103 and supporting passive components to give an analog DC level between 0 and 4.98 V with a resolution of 20 mV. The analog output has a separate analog ground connected to the cabinet.

HF Input

You can add an optional prescaler. This HF input is mounted on the main board, to the right of the input amplifier. It is connected to J19 where there are three pins reserved for ID coding. Preparations have thus been made for other prescalers with different prescaling factors.

■ Prescaler 3.0 GHz, PM9624

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

The prescaler consists of the following parts:

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 consist of two amplifiers each and an AGC control.

Automatic Gain Control (AGC)

– Helps the amplifiers 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

– Supplies a well-regulated voltage to the HF amplifiers.

Software Functional Description

General

The PM 6685 software is divided into two main modules: the GPIB and DEVICE modules. The GPIB fully implements the Message Exchange protocol as described in the IEEE 488.2 - 1987 standard.

The DEVICE module is a real-time measurement executive that can be interrupted to do other tasks, such as handling the keyboard, performing bus commands etc.

The basic structure of the main module is as follows:

```
main PM6685()
{
    Initialize();

    while (TRUE)
        {
            if (BREAKFLAG_KEYBOARD)
                {
                HandleKeyboard();
                }
            if (BREAKFLAG_PRESET)
                {
                PresetDevice();
                }
            if (BREAKFLAG_GPIBCOMMAND)
                {
                ExecuteGpibCommands();
                }
            if (BREAKFLAG_RESTART)
                {
                RestartMeasurement();
                }
            while (not any BREAKFLAG)
                {
                Measure( );
                }
        }
    }
```

All break flags are set by interrupt-driven events, either from external functions (the GPIB interface) or from internal functions (timers etc.).

The **Initialize** procedure does all necessary initialization at power up. It also does the power up tests. See Power-On test in chapter 2.

The **Handlekeyboard** procedure controls all user input/output via the front panel, except displaying the measurement results.

The **PresetDevice** procedure reprograms the complete device when the PRESET key has been pressed (in local mode). It aborts pending measurements.

The **ExecuteGpibCommands** procedure executes GPIB commands and, if a query is received, it starts the response formatter and sends the requested data to the GPIB interface. If the display is switched on, the results are also displayed.

The **RestartMeasurement** procedure aborts pending measurements; the measure loop will later continue to measure. This is mainly used when the RESTART key is pressed.

The **Measure** procedure is the measurement control loop that is used in local mode. It sends its result to the display.

The **ParseGpibInputData** procedure parses the GPIB messages found in the input buffer and sends executable statements to the ExeceuteGpibCommands procedure. The input of data to the input buffer from the external GPIB interface is fully controlled in interrupts. These interrupts are always enabled so the new data bytes can be stored in the input buffer while parsing commands. This **ParseGpibInputDat** is also executed in interrupt.

Test Routines

Test Routines via AUX MENU Key

The test routines are the routines accessible via the AUX MENU key.

Refer to the PM6685 Operators Manual.

Power-On Tests

At power-on some tests are automatically performed. If any of these tests fails, an error message is displayed and the instrument is halted. Pressing the LOCAL/PRESET key makes the device continue independently of the detected error, but without performing the next tests in the start-up sequence.The following tests/actions are performed:

- Write 001 to internal test pins
- Pulse all microcomputer i/o ports twice
- Write 0.1 on display
- Write 0.1.2. on display and 010 on test pins
- Test mC internal RAM (error = Err mC & halt)
- Write 0.1.2.3 to display and 011 on test pins
- Test mC timer (error = Err mC & halt)
- Write 0.1.2.3.4. on display and 100 on test pins
- Test main board RAM (error = Err ra. & halt)
- Write 0.1.2.3.4.5. to display and 101 to test pins
- Test ASIC (error = Err. 5xx & halt)
- Write 110 on test pins
- Check display (light all segments for 2 s)
- Clear Display
- Perform GPIB RAM test if GPIB is installed (error = Err ra. & halt)
- Write 111 on test pins (final value)
- Clear display and start normal measurement procedure

Chapter 5

Repair

Preventive Maintenance

Calibration

To maintain the performance of your counter 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 representative 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 an OCXO will be increased by a factor of 3.

– The temperature stability indicated for the standard oscillator is mainly dependent on the ambient temperature. When the counter is operating there is always an internal temperature increase that 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:

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

Model	**PM6685**			**PM6685R**
Option: Timebase type:	Standard UCXO	PM9691 OCXO	PM9692 OCXO	 Rubidium
Total uncertainty, for operating temperature 0 °C to 50 °C, at 2σ (95%) confidence interval:				
- 1 month after calibration	$< 1.2 \times 10^{-5}$	$< 3 \times 10^{-8}$	$< 8 \times 10^{-9}$	$< 4 \times 10^{-10}$
- 3 months after calibration	$< 1.2 \times 10^{-5}$	$< 4 \times 10^{-8}$	$< 1.2 \times 10^{-8}$	$< 4 \times 10^{-10}$
- 1 year after calibration	$< 1.2 \times 10^{-5}$	$< 1 \times 10^{-7}$	$< 2.5 \times 10^{-8}$	$< 4 \times 10^{-10}$ *
- 2 years after calibration	$< 1.5 \times 10^{-5}$	$< 2 \times 10^{-7}$	$< 5 \times 10^{-8}$	$< 6 \times 10^{-10}$ *
Typical total uncertainty, for operating temperature 20°C to 26°C, at 2σ (95%) confidence interval:				
- 1 month after calibration	$< 4 \times 10^{-6}$	$< 3 \times 10^{-8}$	$< 8 \times 10^{-9}$	$< 1 \times 10^{-10}$
- 3 months after calibration	$< 4 \times 10^{-6}$	$< 4 \times 10^{-8}$	$< 1.2 \times 10^{-5}$	$< 2 \times 10^{-10}$
- 1 year after calibration	$< 7 \times 10^{-6}$	$< 1 \times 10^{-7}$	$< 2.5 \times 10^{-8}$	$< 2.5 \times 10^{-10}$ *
- 2 years after calibration	$< 1.2 \times 10^{-5}$	$< 2 \times 10^{-7}$	$< 5 \times 10^{-8}$	$< 5 \times 10^{-10}$ *

* *After 1st year of operation. For 1st year add: $< 3 \times 10^{-10}$*

Table 5-1 *Stability of timebase oscillators.*

Example:

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

$$(\textit{Acceptable error}) = \frac{3}{10\times10^{6}} = 3\times10^{-7}$$

The aging and temperature factors can be selected from the table on page 5-2.

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 PM9691 oscillator.

– Look up information about PM9691 in the table on page 5-2. 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 $3 * 10^{-8}$

– Aging/year: Less than $1.5 * 10^{-7}$

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

$$\frac{3\times10^{-7} - 3\times10^{-8}}{1.5\times10^{-7}} = 1.8 \ \textit{year}$$

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

When to Replace the Fan (PM6685R only)

To maintain the high reliability of a counter used in around-the-clock' applications, you must replace the fan every second year. For part time and low ambient temperature use, you can extend this service interval to 6-10 years or more. Additional information can be found in Chapter 9, Appendix.

Troubleshooting

General

Quick Troubleshooting

The PM6685 is a highly integrated Frequency counter with dedicated LSI counter circuits and microcontrollers that control the complete units. The microcontroller can help you locate faulty parts by running test programs and generating stable signal patterns on t he 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 troubleshooting must be performed.

Where to Start

After reading the safety instructions, continue with this chapter for troubleshooting 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.

Logic Levels

The PM6685 contains logic of four families. The levels for these families are listed in the following table.

	Positive ECL	Negative ECL	CMOS	TTL
Supply voltage	+5 V	-5.2 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 *Logic levels.*

Required Test Equipment

To test the instrument properly using this manual, you will need the equipment listed below. The list contains specifications for the critical parameters.

Type	Performance
DMM	3.5 digits
Oscilloscope	300 MHz 2-channel
Signal generator	3300 MHz
Power supply	12 V/2 A
BNC-BNC 50 Ω cables	RG-58

Table 5-3 *Required test equipment.*

PROM Identification

There are two different PROMs in the PM6685, one on the main PCB containing the instrument firmware, the other on the optional GPIB board, containing the interface bus firmware.

They have labels with version designation of the traditional form Vx.yz, where x, y, and z are digits. The last digit can be followed by a single letter. The version numbers do not have to coincide, except for the last letter. So the combination Vr.stE and Vu.vwE is valid, whereas Vr.stE and Vu.vwF is not.

Operating Conditions

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

Introduction

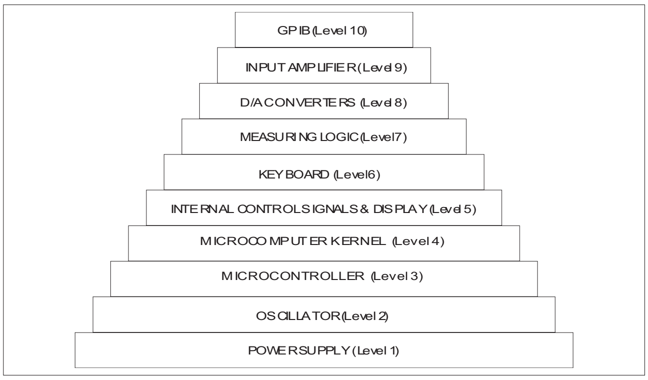

Fig. 5-1 *Functional levels.*

The troubleshooting strategy for the PM6685 is an integrated part of the overall service strategy for the instrument. This instrument is hierarchically designed in different levels, and troubleshooting can be performed in any design level if the lower levels are OK. It is, therefore, important to disconnect all options at the beginning of the troubleshooting procedure.

Power Supply

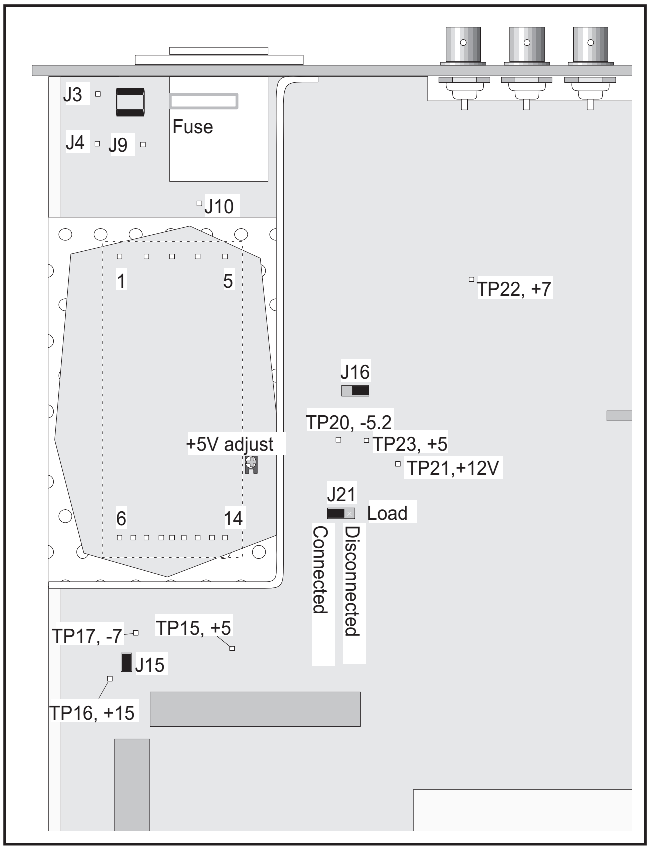

Fig. 5-2 *Test points and trimmers for the power supply.*

Connect the counter to line power.

– Set the counter to STAND-BY mode.

– Check that the voltage between J9 and J10 is in the range of 90 to 260 VAC, (see Fig. 5-2).

– Check that the input voltage to the power module, U39 between pin 1 and pins 4 and 5 on the bottom side of the PCA, is 120 to 375 VDC.

– Move the jumper J16 to the DISCONNECT position.

– Check the “STAND BY” voltages after the power module, U39. Use for instance the screen around the input amplifier as ground connection. There are also a number of ground pads on the PCB available for this purpose.

Test Points	Voltage
TP15	+5.10 V ± 10 mV*
TP16	+14.8 V to +21 V
TP17	–12.5 V to –7.5 V
TP21	+12 V ± 0.5 V

Table 5-4 *Standby voltages.*

**NOTE: If this voltage does not meet the above-mentioned spec, and if it is not possible to adjust it, the output resistances of the module must be checked.*

To verify the Power Module 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 measurements.
– Disconnect L6 and check the resistance between pin 1 and pins 4 and 5 on the power module. The DMM should not show a short circuit. Put L6 back.
– Check that the DC voltage between pin 1 and pins 4 and 5 on the power module is about √2 times the input AC-voltage. If not, use traditional troubleshooting techniques to locate the fault.
– Remove the power cable from the counter.
– Measure the resistances according to the table below.

Test Pins	Resistance
(GND) and TP15 (+5 V)	≈10 Ω
(GND) and TP16 (+15 V)	≈1.5 kΩ
(GND) and TP17 (–7 V)	≈270 Ω

Table 5-5 *Output resistances.*

– If one of the above-mentioned measurements shows 0 Ω, remove L7, L8, and L9 and use conventional troubleshooting techniques to isolate the fault.
– Measure the resistances according to the table below.

Test Pins	Resistance
10, 11 and 13, 14	≈150 Ω
8 and 9	≈1.5 kΩ
6 and 7	≈270 Ω

Table 5-6 *Output resistances.*

If the resistances deviate considerably from the values in the table, the complete power module must be replaced.

– Move jumper J16 to the CONNect position.

– Connect the power cable to the counter.

– Switch the counter ON.

– Check the “POWER ON” voltages.

Test Points	Voltage
TP23	+5.06 V ± 30 mV*
TP20	–5.2 V ± 50 mV
TP22	+7 V ± 100 mV

Table 5-7 *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. Also refer to Power Supply in Chapter 4, Circuit Descriptions.

Oscillator

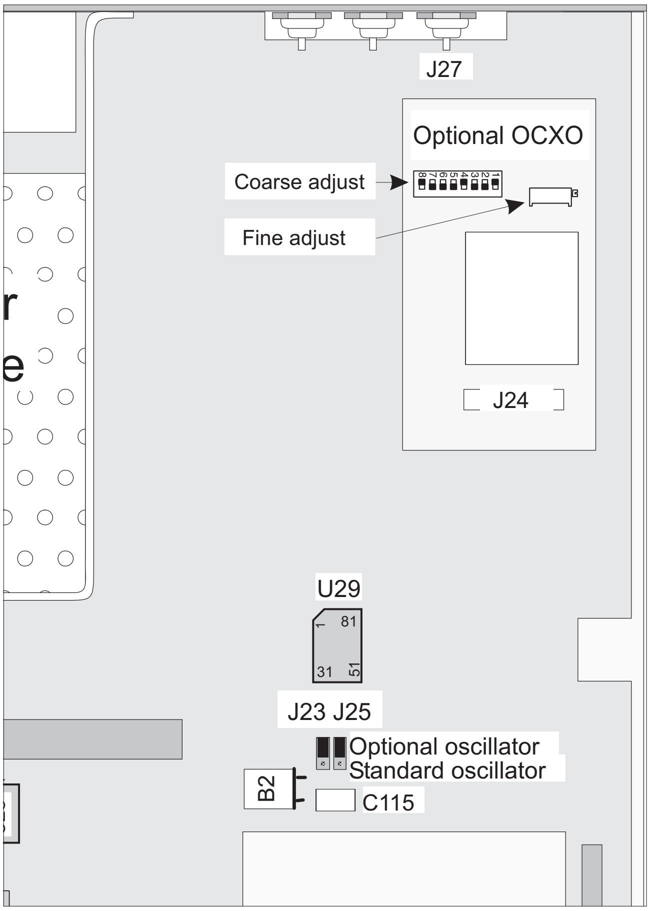

Fig 5-4 *Trimmers for the reference frequency oscillators.*

■ Standard Oscillator

– Be sure the jumpers J23 and J25 are in the STD position, (see Fig. 5-4).

– Check that 10 MHz is present at U29, pin 42.

– Check that 10 MHz is present at the rear panel connector 10 MHz OUT (J27).

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

■ OCXO, PM9691 or PM9692

This test can be carried out only if the counter is equipped with one of the optional oscillators, PM9691 or PM9692.

– Be sure the jumpers J23 and J25 are in the OPT position, (see Fig. 5-4).

– Check that 10 MHz is present at U29, pin 42.

– Check that 10 MHz is present at the rear panel connector 10 MHz OUT (J27).

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

Microcontroller

– Check that 6 MHz is present at U11, pin 65 (see Fig.5-3).

– Check that the RESET circuit U10 works properly by moving

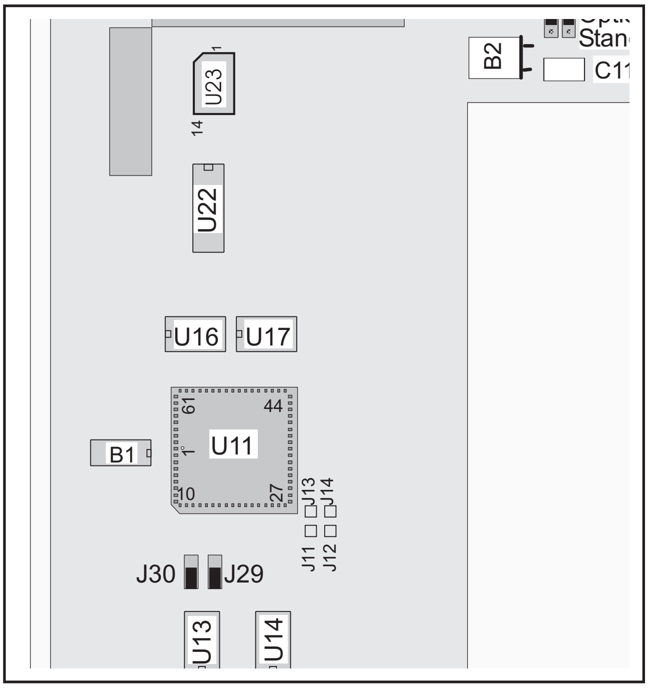

Fig. 5-3 *Test points and jumpers for checking the microcontroller.*

the RESET jumper J29 temporarily to the ON position.

If the CPU is not running, check the state of the pins J11-J13. See table below.

Display	JP11, J12, J13	Message	Error	Action
0.1	0, 0, 1	-	µC I/O port error	Replace U11
0.1.2	0, 1, 0	Err UC	µC internal RAM error	Replace U11
0.1.2.3	0, 1, 1	Err UC	µC timer error	Replace U11
0.1.2.3.4	1, 0, 0	Err rA	RAM error	Replace U22
0.1.2.3.4.5	1, 0, 1	Err ASIC	ASIC error	Replace U29
All segments	1, 1, 0			
	1, 1, 1	Err rA	GPIB RAM error	Replace U111 on GPIB board
			Test OK	

Table 5-8 *Start-up test.*

If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. Also refer to Chapter 4, Circuit Descriptions.

NOTE: Check that activity is going on at U11 pin 62 (ALE), pin 61 (RD), pin 63 (INST), and pin 43 (READY). These pins should not be stuck HIGH or LOW.

– If one or more bits on the AD-bus are corrupt, the microcontroller (µC) often reads the same instructions repeatedly. When the µC discovers an 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 U11, (pin 16). If +5 V to U10 is OK, this could be the cause of trouble.

Input Amplifier

■ A Input Check

DC levels

– Switch on the counter.

– Press LOCAL/PRESET and ENTER.

– Deselect AUTO and set the sensitivity to 1 Vrms.

– Measure the DC voltages according to Fig. 5-5. Use the DMM with a 10 kΩ resistor in series with the test cable.

AC levels

– Connect a 1000 Hz sine wave signal with an amplitude of 1 V_{pp} to Input A.

– Measure the AC-levels according to Fig. 5-5. Use the oscilloscope and a 10 MΩ probe.

If you find any fault, continue with traditional troubleshooting techniques and replace defective circuits. Also refer to Input Amplifiers A and B in Chapter 4, Circuit Descriptions.

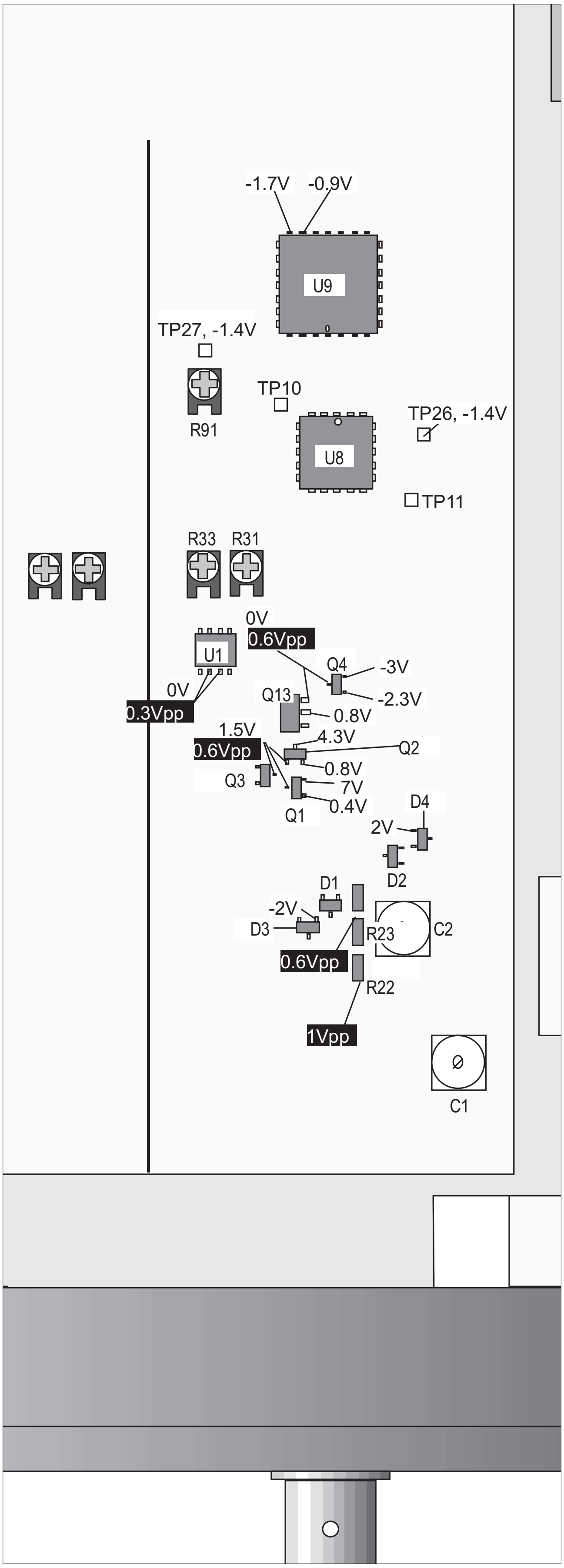

Fig. 5-5 *Typical voltages, input amplifier.*

■ Prescaler 3.0 GHz, PM9624

See Chapter 2, Performance Check, for verification.

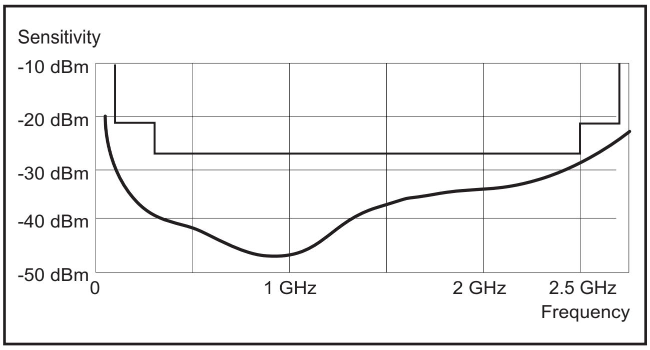

Fig. 5-6 *Specified and typical sensitivity of input C (PM9624).*

This prescaler cannot be repaired in a local workshop. It must be sent to your Fluke representative for repair.

GPIB Interface and Analog Output

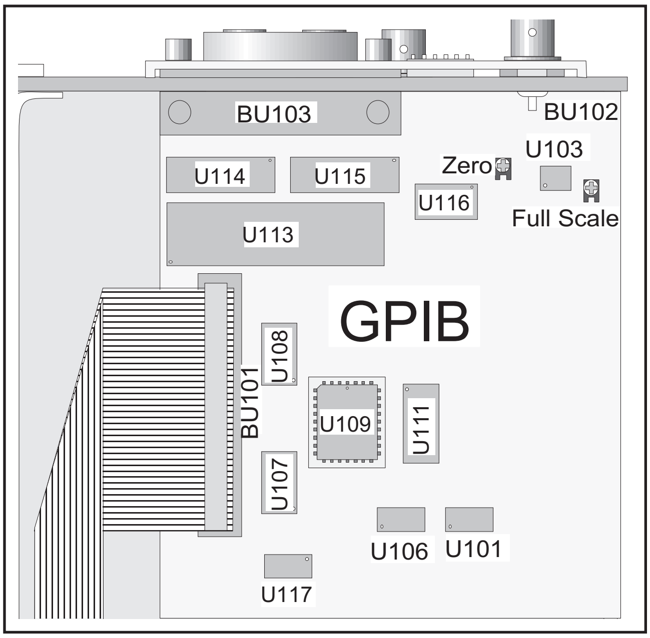

Fig. 5-7 *Component layout, GPIB interface.*

■ General Remark

If the GPIB board is suspected to be faulty, be sure the basic instrument is OK by performing a few functional checks after the ribbon cable has been disconnected from J18.

■ Analog Output

The microcontroller generates a PWM signal that is applied to pin 1 on U101. The frequency is approximately 20 Hz, but the duty cycle is dependent on several factors like the frequency of the measured signal, the measurement time, and the selected scaling factor.

The PWM signal is converted to a DC voltage between 0 V and 4.98 V by integration, first in a passive RC network (R101, C103, R102, C102 and then in an active integrator U103.

Setup

– Connect the counter to line power.

– Switch on the counter.

– Press PRESET and then ENTER.

– Connect a DMM to the BNC output BU102.

– Activate the analog output.
  – Select AUX MENU.
  – Press DATA ENTRY ▲/▼ until the display reads ANALOG OUT.
  – Press ENTER
  – Press DATA ENTRY ▲/▼ to select ON.
  – Press ENTER.
  – Press DATA ENTRY ▲/▼ until the display reads 1.0^{-3} V.
  – Press ENTER.

– Connect a LF synthesizer to Input A on the counter.

– Set the synthesizer to 500 Hz, 1 V_{PP}

– Read the DMM result. The voltage should be 2.49 V ± 35 mV.

Minor deviations can depend on the settings of the trimmer potentiometers for ZERO and FULL SCALE. See Chapter 6, Calibration Adjustments, for a decription of the procedure to follow.

Large deviations indicate a fault. Trace the signal through the integration chain with traditional troubleshooting techniques and replace defective circuits. The duty cycle at U101:1 should be 50 %. Also refer to *GPIB Interface Including Analog Output* in Chapter 4, Circuit Descriptions.

■ Bus Interface

A simple method to check the most fundamental functions of the interface is to send the standardized query message ∗IDN? and check the response string.

Setup

– Make sure you have access to a PC with GPIB capability.

– Check that there is a program installed that can send simple commands entered via the keyboard and that can receive and display the response strings.

– Connect the GPIB connectors of the counter and the PC by means of a standard GPIB cable.

– Set the address switches on the counter (the five rightmost ones seen from the rear) so that their binary weight corresponds to the wanted decimal value between 0 and 30.

– Send the command ∗IDN? to the counter and observe the response string. See the programming manual for more information on the response format and contents.

– You can also try the command ∗OPT? to get a listing of installed options (except OCXO).

If you find a fault, continue with traditional troubleshooting techniques and replace defective circuits. Try to exercise the address/data bus by writing small program loops. Look for stuck nodes with an oscilloscope.

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, bend component pins 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 be replaced only by components obtained from your local Fluke representative.

Checking 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 show a defect.

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Chapter 6

Calibration Adjustments

Introduction

Required Test Equipment

Type	Performance
DMM	Acc. 0.02% / Res. 1µV
HF synthesizer	3300 MHz
Pulse generator	125 MHz / 2 ns rise/fall time
LF synthesizer	50 MHz / 20 Vpp
Oscilloscope	300 MHz / 2-channel
Passive probe	10:1, preferably 500 Ω (or well compensated 10 MΩ)
FET probe	300 MHz
Power supply	12 V / 2 A
Power splitter	50 Ω / 4W
Feed-through termination	50 Ω
10 MHz reference	$1x10^{-7}$
10 MHz reference	$1x10^{-9}$*
BNC-BNC cables	Different lengths
Screwdrivers	Torx 10 & 20

Table 6-1 *Required test equipment.*

* For adjustment of PM9691 and PM9692 Oven Oscillators only.

Note: Only calibrated instruments should be used.

Preparation

WARNING: Live parts and accessible terminals which can be dangerous to life are always exposed inside the unit when it is connected to 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 30 minutes to let it reach normal operating temperature.

Power Supply

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

■ Setup

– Remove the protective cover above the power module.

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

– Connect the counter to line power.

– Switch on the counter.

– Press PRESET, then press ENTER.

NOTE: The backlight must be switched on during the adjustment of the power module.

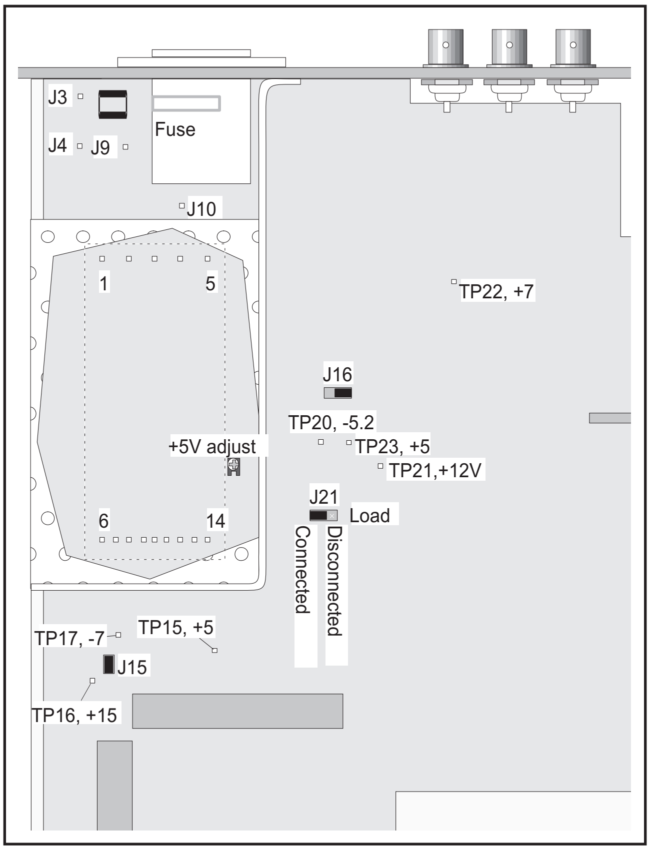


Fig. 6-1 *Test points and trimmer for the Power Supply.*

■ Adjustment

– Connect the DMM to test point TP15 = +5V and GND, (see Fig. 6-2).

– Adjust the +5V trim potentiometer inside the power module until the DMM reads +5.10 ± 0.01 V.

– Check that the voltage between the test point TP23 = +5 V and GND is +5.06 ± 0.03 V.

– Check that the unregulated voltage from the power module at test point TP16 = +15 V is about +18 V.

– Check that the unregulated voltage from the power module at test point TP17 = –7 V is about –8 V.

– Reinstall the protective cover onto the power module.

Input Amplifier

The instructions in this section are consecutive. Do not change a setting until you are told to do so, either in the text or in the tables.

■ Setup

– Remove the screen shield before performing any adjustments in the input amplifier.

– Connect the counter to line power.

– Switch on the counter.

– Press PRESET, then press ENTER.

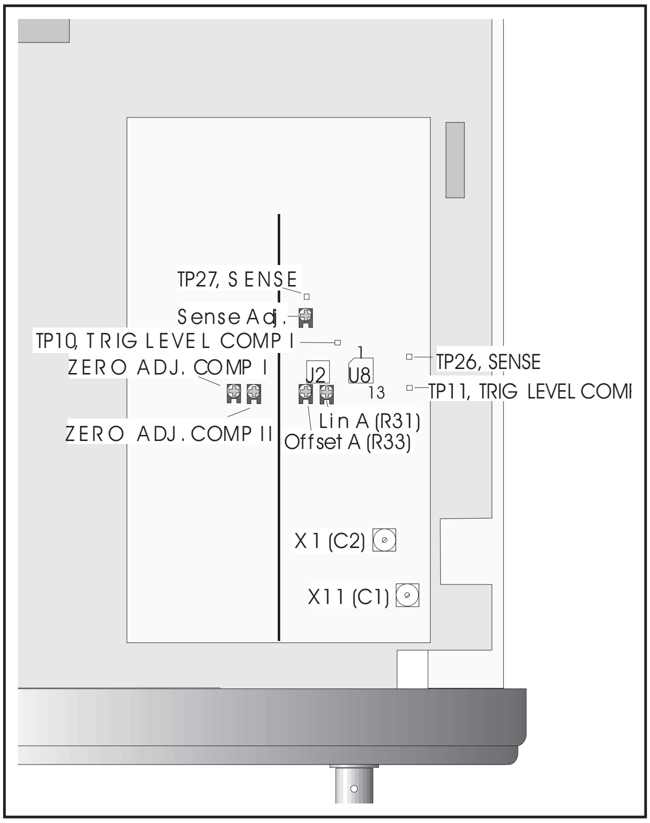


Fig. 6-2 *Test points and trimmers for the Input amplifiers.*

Offset

– Connect the DMM to Pin 10 of U8 and GND = screen, see Fig. 6-2. Pin 1 is marked in the figure and is the middle pin on the side closest to the rear of the unit. Alternatively you can use one of the soldering pads of resistor R114 as a test pad, as it is connected to Pin 10. This resistor is normally not mounted.

– Adjust R33 = OFFSET A until the DMM reads 0.0 ±0.2 mV.

Linearity

■ Setup

– Press the Waveform Key once. (This step puts the instrument into the correct mode so that it switches from x1 Attenuator to x11 Attenuator when the sensitivity is adjusted above 2.8V.)

– Connect the pulse generator to the A input of the counter via the power splitter.

– Connect the other output from the power splitter to channel A of the oscilloscope.

PM6685	Input A	50 Ω
	Sensitivity	Any level below 1 V_{rms}
Pulse generator	Amplitude	5 V_{pp} in 50 Ω
	Period	2 ms, symmetrical
Oscilloscope	Time	200 µs/div
	Setting: A	0.5 V/div, 50 Ω, DC
	Setting: B	20 mV/div, 10:1 probe, DC

Table 6-2

NOTE: The Pulse Generator with 50 ohm output impedance should be set to 5 V_{pp} when loaded in 50 Ω, so that the level recorded at the CRO A channel (equal to the input to the DUT) is 2.5 V_{pp}, after going through the splitter.

NOTE: If you are using a 10 MΩ x10 CRO probe, ensure that its compensation has been correctly adjusted, so that incorrect observations of undershoots/overshoots are not made.

– Use the probe to connect channel B of the oscilloscope to Pin 10 of U8 .

– Adjust R31 = LIN A until both signals look as alike as possible.

NOTE: The AC coupling will give the curve a slight tilt.

x1 Attenuator

■ Setup

PM6685	Impedance	50 Ω
	Sensitivity	Any level below 1 V_{rms}
Pulse generator	Amplitude	5 V_{pp} in 50 Ω
	Period	100 µs, symmetrical
Oscilloscope	Time	10 µs/div
	Setting: A	0.5 V/div, 50 Ω, DC
	Setting: B	20 mV/div, 10:1 probe, DC

Table 6-3

– Adjust C2 = X1 until both signals on the screen look as alike as possible, without any overshoots or undershoots. The level displayed on the CRO B channel for Pin 10 of U8 is approximately 1.2 V_{pp}.

x11 Attenuator

■ Setup

PM6685	Impedance	50 Ω
	Sensitivity	Any level above 2.8 V_{rms}
Pulse generator	Amplitude	5 V_{pp}
	Period	100 µs, symmetrical
Oscilloscope	Time	10 µs/div
	Setting: A	0.5 V/div, 50 Ω, DC
	Setting: B	5 mV/div, 10:1 probe, DC

Table 6-4

– Adjust C1 = X11 until both signals on the screen look as alike as possible, without any overshoots or undershoots.

– Observe that the level displayed on the CRO B channel for Pin 10 of U8 is now approximately 120 mV_{pp}, indicating that the x11 Attenuator has been selected.

Trigger Levels

■ Setup

PM6685	Impedance	50 Ω
	Sensitivity	10 mV_{rms}

Table 6-6

– Disconnect all input signals to the counter.

■ Zero levels

Channel A

– Connect the DMM to test points TP10 = TRIG LEVEL COMP I and GND = screen.

– Adjust R69 = ZERO ADJ COMP. I until the DMM reads +0.95 ± 0.05 mV.

– Connect the DMM to test points TP11 = TRIG LEVEL COMP II and GND=screen.

– Adjust R70 = ZERO ADJ COMP. II until the DMM reads –0.95 ± 0.05 mV.

Sensitivity

■ Setup

– Measure the DC voltage between test points TP26="–" and TP27="+", (see Fig. 6-2).

– Adjust R91 = SENSE until the DMM reads 10 ± 0.2 mV.

Offset

■ Setup

PM6685	Impedance	50 Ω
	Sensitivity	10 mV_{rms}
Signal generator	Amplitude	–18 dBm
	Frequency	50 MHz

Table 6-5

– Connect the Signal generator to the A input of the counter.

– Press NULL on the counter.

– Decrease the amlitude from the signal generator to –28 dBm.

– Adjust R33 = OFFSET A until the counter reads < ±100 Hz.

– If this is not possible, adjust R91= SENSE until the counter reads < ±100 Hz.

NOTE: Reinstall the screen shield after making these adjustments.

Reference Oscillators

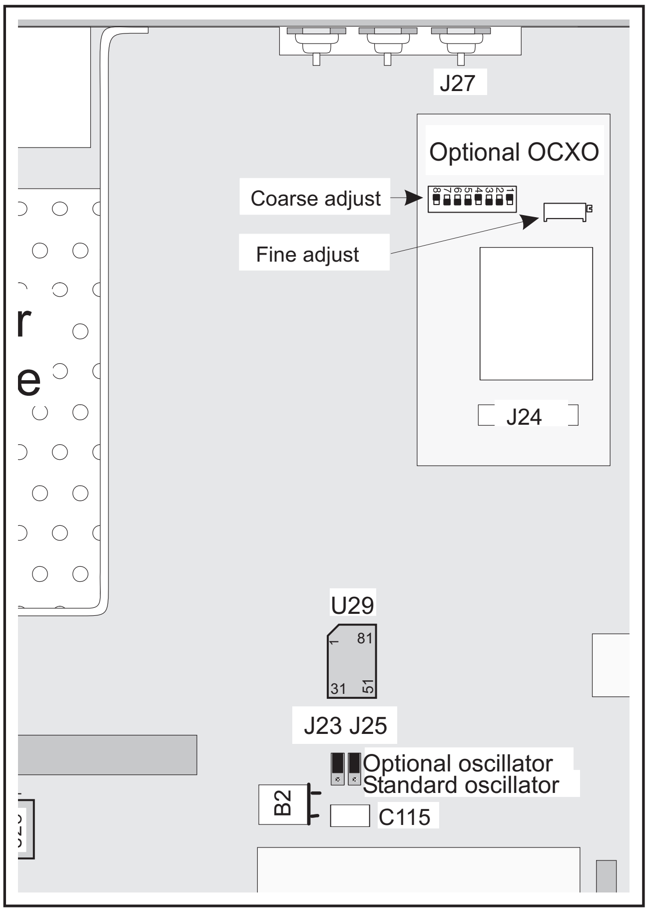


Fig. 6-3 *Trimmers for the reference oscillator frequency.*

NOTE: The standard oscillator is always mounted in the unit, even if an optional oscillator is installed. You set the jumpers J23 and J25 to select the timebase source that you want to use.

Standard Oscillator

■ Setup

– Connect the counter to line power.

– Switch on the counter.

– Press PRESET, then press ENTER.

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

– Press CHECK, NULL, and CHECK again.

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

■ Adjustment

– Adjust C115 = STD OSC ADJ, until the counter reads 10 MHz ± 5 Hz.

NOTE: Move the two jumpers J23 and J25 back to position OPT if an optional oscillator is installed.

Oven-Controlled Oscillators (OCXO), PM9691 & PM9692

PM9691 is adjusted to 10 MHz ± 0.2 Hz when manufactured, 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 User's Handbook, Chapter 11, to calculate when calibration is due. The complete specifications can be found in the same manual, Chapter 12.

Required test equipment

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

Table 6-7

■ 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.

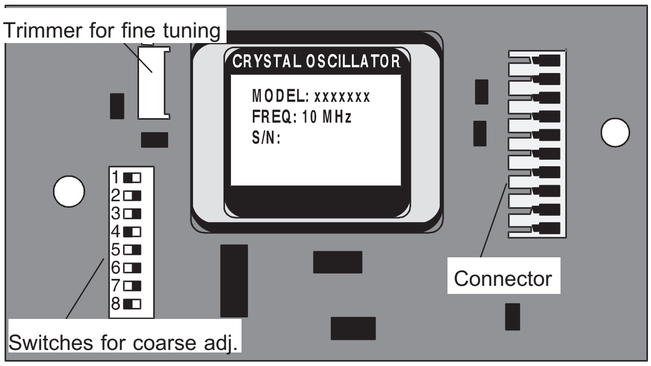


Fig. 6-4 *Adjusting the optional oscillator frequency.*

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 6-8

NOTE: There are also oscillators that do not have DIP switches. If this is the case, then the trimmer potentiometer alone covers the whole adjustment range.

Other Options

HF Input 3.0 GHz , PM9624

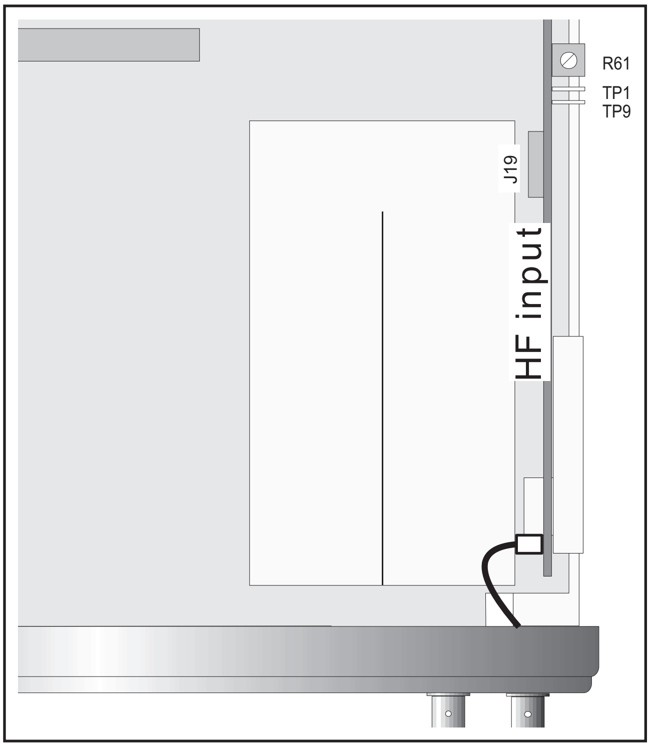


Fig. 6-5 *Test points and trimmers for the 3.0 GHz HF input.*

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

PM6685	Function	FREQ C
Signal generator	Frequency	800 ± 25 MHz
	Amplitude	5.9 ± 0.5 mV_{rms}

Table 6-9

– Connect the counter to line power.

– Switch on the counter.

– Press PRESET, then press ENTER.

– Connect the signal generator to the HF input.

■ Adjustment

– Turn the potentiometer R61, (see Fig. 6-5) fully counterclockwise.

– Check that the GATE indicator stops blinking.

– Turn R61 slowly clockwise until the GATE indicator starts blinking.

The input frequency, 800 ± 25 MHz, will now be displayed.

To verify the 3.0 GHz HF input, a sweep frequency synthesizer is needed. Also refer to Chapter 2 - Performance Check: Options, Prescaler.

GPIB Interface, PM9626B

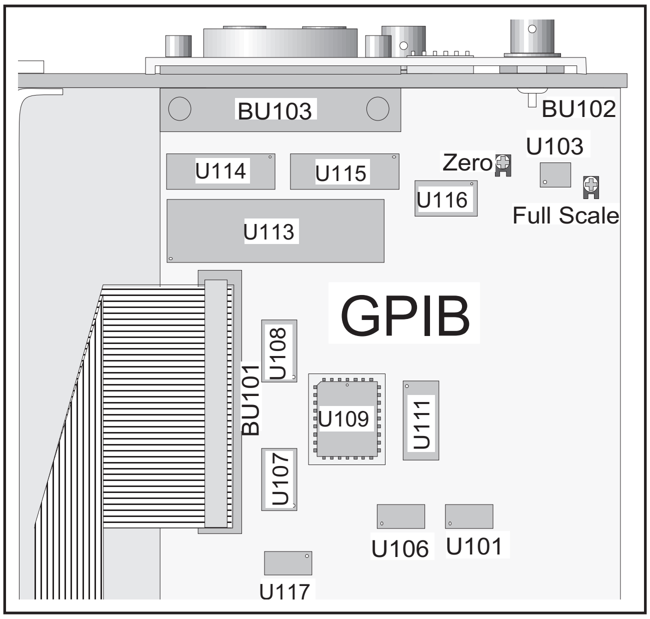


Fig. 6-6 *Trimmers for the GPIB interface.*

■ Setup

PM6685	Input A	50 Ω / AC / Manual trigger levels
LF synthesizer	Amplitude	1 V_{pp}
	Period	1000.01 Hz square wave

Table 6-10

– Connect the counter to line power.

– Switch on the counter.

– Press PRESET, then press ENTER.

– Connect the DMM to the BNC output of the analog output.

– Activate the analog output.
  – Select AUX MENU.
  – Press DATA ENTRY UP/DOWN keys until the display reads ANALOG OUT.
  – Press ENTER.
  – Press DATA ENTRY UP/DOWN keys to select ON.
  – Press ENTER.
  – Press DATA ENTRY UP/DOWN keys to until the display reads 1.0^{3} V.
  – Press ENTER.

– Connect the LF synthesizer to the A input of the counter.

The counter should read 1000.0xxxxx Hz.

■ Adjustment

– Adjust the trimmer ZERO (see Fig. 6-6) until the output voltage is 0 V ± 1 mV.

– Set the LF synthesizer to 999.90 Hz / 1 V_{pp} square wave.

The counter should read 999.9xxxxx Hz.

– Adjust the trimmer FULL SCALE (see figure 6-6) until the output voltage is 4.980 V ± 3 mV.

– Set the LF synthesizr to 100.01 Hz / 1 V_{pp} square wave.

The counter should read 100.0xxxxxx Hz.

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

Chapter 7

Replacement Parts

Introduction

Standard Parts

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

Standard parts are unmarked or marked with an 'S' in the ✰ column of the parts lists.

Special Parts

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

– Components that are manufactured or selected by the manufacturer to meet specific performance requirements.

– Components that are important for the safety of the instrument.

Both types of components may be replaced only by components obtained through your local Fluke organization.

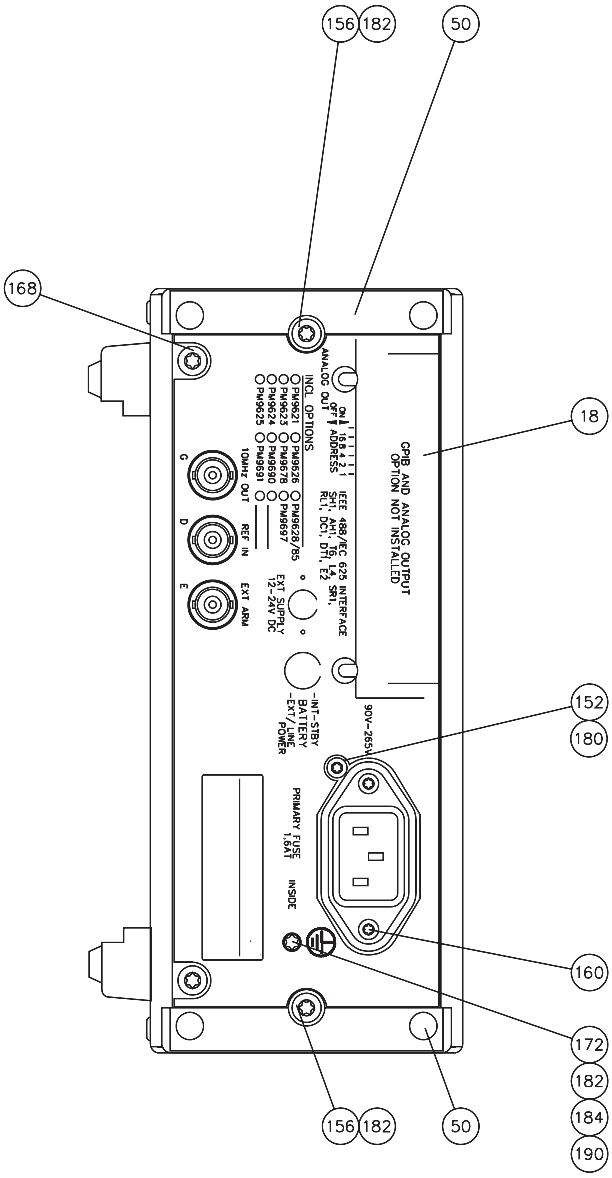
NOTE: Physical size and shape of a component may affect the performance of the instrument, particularly at high frequencies. Always use direct replacements unless it is known that a substitute will not degrade the performance of the instrument.

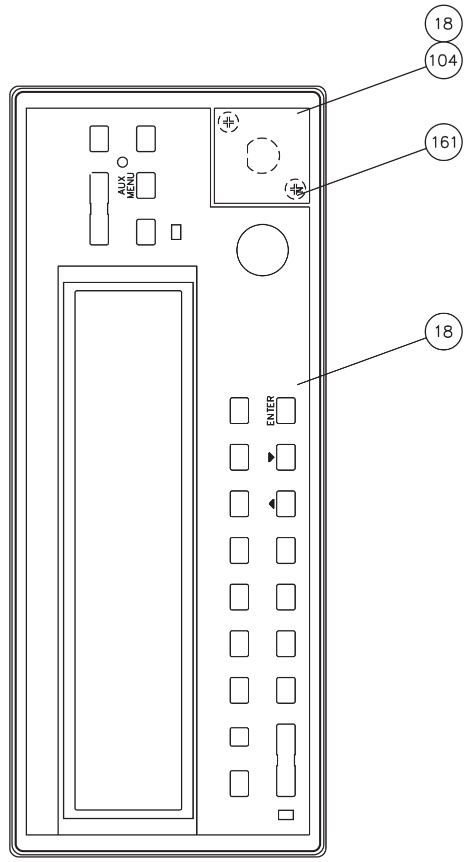
These parts are 'Recommended Replacement Parts' and are marked with an 'R' in the ✰ column of the parts lists.

Components 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

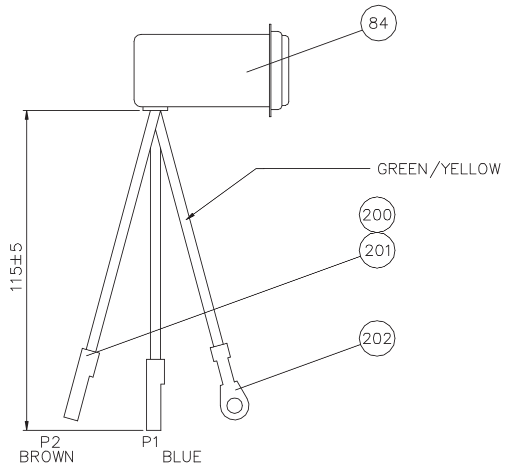
Pos	Description	Part Number	P
	PCA 1, Main board	4031 100 65420	P
	PCA 2, Front board	4031 100 48250	P
13	Stand-off, plastic	5322 532 12746	R
18	Textplate kit	4031 100 62430	R
20	Rubber keypad	4031 100 62720	R
22	Cover and Front panel	4031 100 49570	R
25	Rear panel	5322 447 31085	P
34	Profile-support	5322 460 60542	P
35	Profile-support	4031 100 53210	P
38	Shield cover	5322 447 91931	P
39	Shield cover	5322 462 50459	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 63808	R
56	Rubber foot, sj-5018 black	5322 462 44434	R
58	Tilting support	5322 401 11471	R
62	Coax connector	5322 267 10004	S
63	Coax connector	5322 265 10264	R
64	Soldering tag, 9.6X15/15 ms fs	5322 290 30318	S
67	Toroid core 30nh rcc9/6/3 4c65 violet	5322 526 10545	P
68	Bottom shield	5322 447 91829	P
70	BNC holder	4031 100 48830	P
84	Mains filter 1a fs3514-1/07	5322 121 42352	R
90	PCA guide for prescaler	5322 401 11347	P
92	Stand-off nut M3x14	4031 100 48800	P
100	Washer, 4.0X10x2 pa6-6	5322 532 52364	P
102	Washer, 9.5X13x2.3	4822 532 10222	P
104	BNC plate, 25.4X25.4	5322 466 82868	P
110	Insulate plate	5322 466 61932	P
122	Shielding strip 610mm 99-210 self-adhesive	5322 466 62077	P
150	Screw, mrt-kombi 3x06, stfz	4822 502 11658	P
152	Screw, mrt-kombi 3x08, stfz	5322 502 21489	P
156	Screw, mrt-kombi 4x16, stfz	5322 502 21491	P
160	Screw, mft-tt 3x08 stfzb tx	4822 502 11713	P

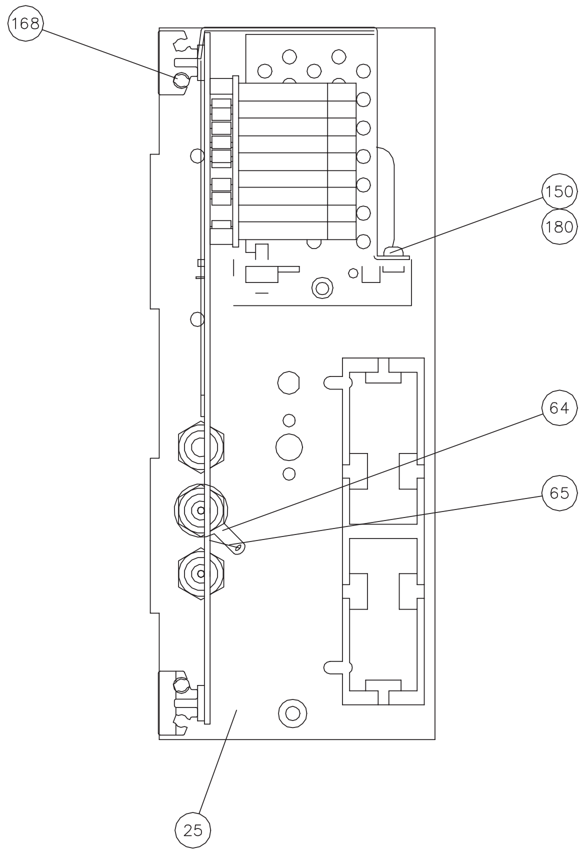


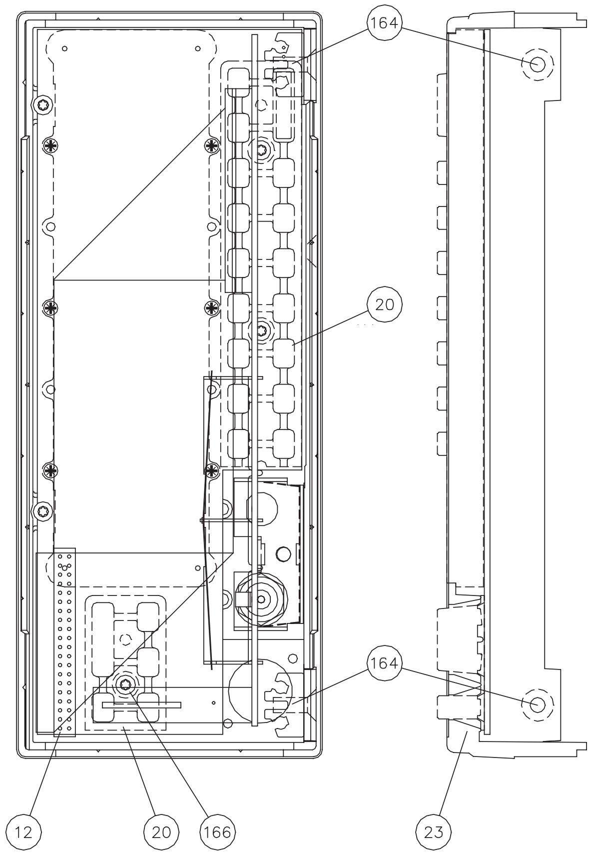


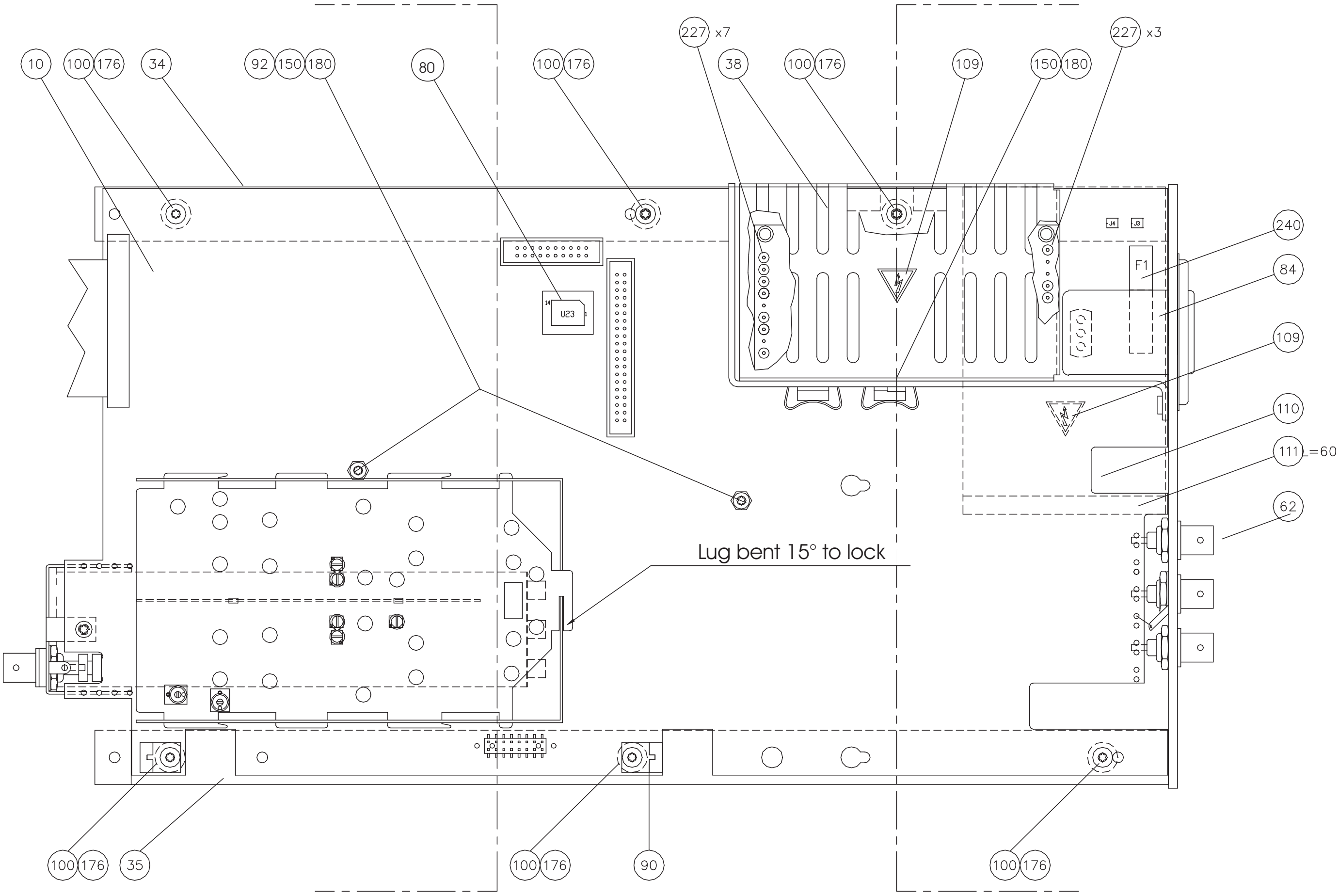
Pos	Description	Part Number	P
161	Screw, mfx-tt 3x08 st fz poz	4822 502 11713	P
164	Screw, mft-tt 4x12 stfzb tx	5322 502 13553	P
166	Screw, mrt-tt 3x08 stfzb tx	4822 502 11691	P
168	Screw, mrt-tt 4x16 stfzb tx	5322 502 13552	P
172	Screw, mft 4x10 st fzb, tx	5322 502 13641	P
176	Screw, rtk-ko st3.5X10 stfz	5322 502 30703	P
180	Spring washer, kba 3.2 St fz din137	4822 530 80173	P

Pos	Description	Part Number	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 transp pa	5322 321 40117	P
202	Cable clip, reel srb-2.5T-m4	5322 358 50107	P





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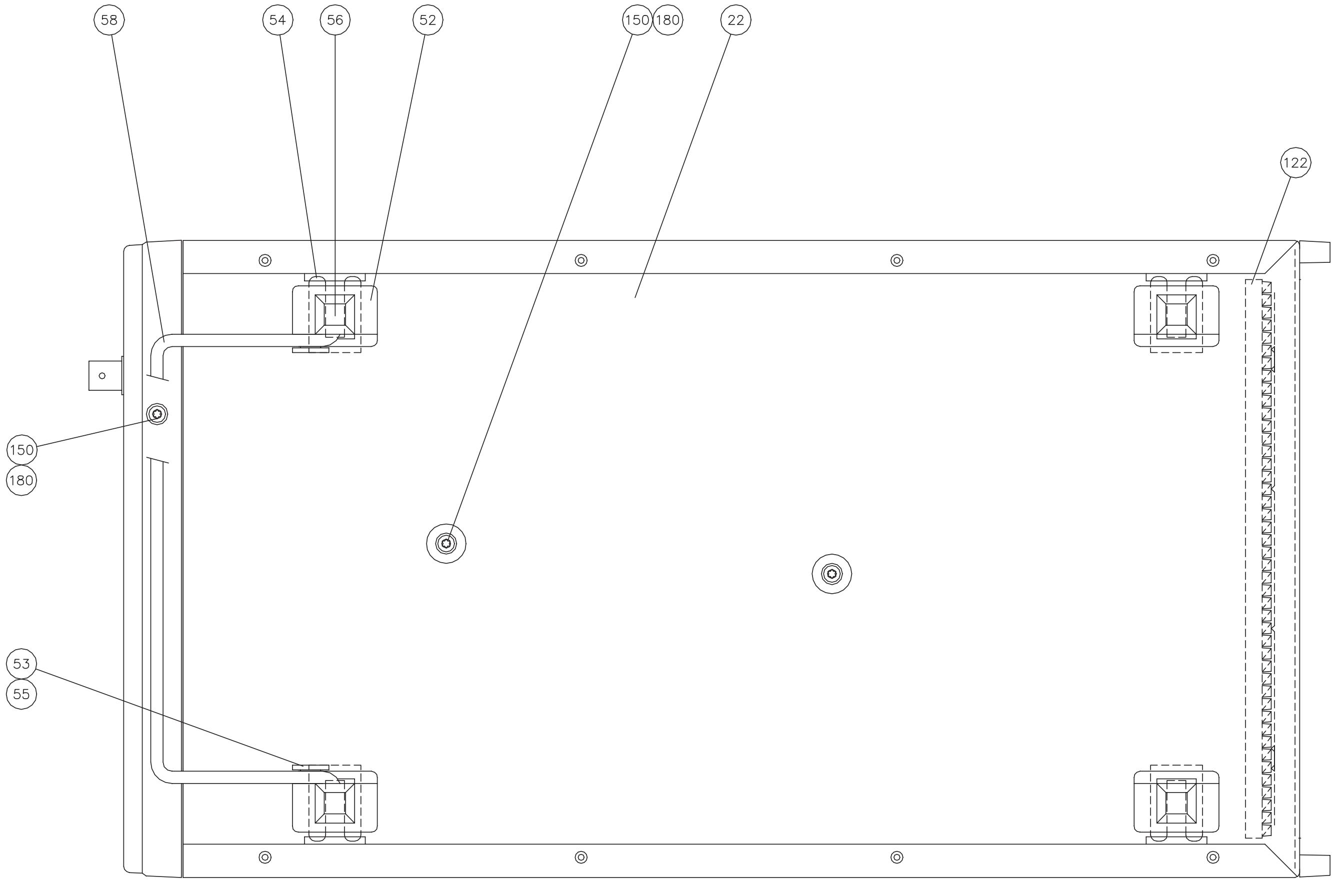
100 176
34
92 150 180
80
100 176
227 x7
38
100 176
109
150 180
227 x3
240
F1
84
109
110
111 L=60
62
U23
Lug bent 15° to lock
100 176
35
100 176
90
100 176


58
54
56
52
150 180
22
122
150
180
53
55

Main Board

Pos	Description	Part No.	☆
227	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
B1	CRYSTAL 12.000 MHz SMD MA-406	2422 543 01353	P
B2	CRYSTAL 10 MHz HC-49U/13	5322 242 82118	P
C1	CAPACITOR-TRIM 0.5-2 pF 300V	5322 124 80335	S
C10	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C100	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C101	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C102	CAPACITOR 33 pF 5% 50V NP0 0805	2222 861 15339	S
C103	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C104	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C105	CAPACITOR 6.80 UF 20% 16V 6.0X3.2 MOLD	5322 124 10687	R
C106	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C107	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C108	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C109	CAPACITOR 22 pF 5% 50V NP0 0805	5322 122 32658	S
C11	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C110	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C111	CAPACITOR 15 UF 20%6.3V 6.0X3.2 MOLD	5322 124 11418	S
C112	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C113	CAPACITOR 82 pF 5% 50V NP0 0805	2222 861 15829	S
C114	CAPACITOR 100 pF 5% 50V NP0 0805	2222 861 15101	S
C115	CAPACITOR-TRIM 3-10 pF TZBX4Z100BB110	5322 125 50306	R
C116	CAPACITOR 47 pF 5% 50V NP0 0805	2222 861 15479	S
C117	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C118	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C119	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C12	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C120	CAPACITOR 10 pF 5% 50V NP0 0805	2222 861 15109	S
C121	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C122	CAPACITOR 680 pF 20% 63V NP0 1206	4822 126 12075	S
C123	CAPACITOR 47 pF 5% 50V NP0 0805	2222 861 15479	S
C124	CAPACITOR 100nF 20% 25V X7R 0805	5322 126 13638	S
C125	CAPACITOR 2.20 UF 20% 6.3V 3.2X1.6 MOLD	5322 124 10685	S
C126	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C127	CAPACITOR 1 nF 20% 50V X7R 0805	5322 122 34123	S
C128	CAPACITOR 82 pF 5% 50V NP0 0805	2222 861 15829	S
C129	CAPACITOR 6.8 pF 5% 50V NP0 0805	2222 861 15688	S
C13	CAPACITOR 47 pF 5% 50V NP0 0805	2222 861 15479	S
C130	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C131	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C132	CAPACITOR 2.20 UF 20% 6.3V 3.2X1.6 MOLD	5322 124 10685	S
C133	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C134	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C135	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C136	CAPACITOR 15 UF 20% 6.3V 6.0X3.2 MOLD	5322 124 11418	S
C138	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C139	CAPACITOR 15 UF 20% 6.3V 6.0X3.2 MOLD	5322 124 11418	S
C14	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C140	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C141	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C142	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C143	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C145	CAPACITOR 390 pF 5% 50V NP0 0805	4822 122 32636	S
C146	CAPACITOR 10 pF 5% 50V NP0 0805	2222 861 15109	S
C148	CAPACITOR 470 pF 1% 63V NP0 0805	5322 126 14051	S
C149	CAPACITOR 22 pF 5% 50V NP0 0805	5322 122 32658	S
C15	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C150	CAPACITOR 390 pF 5% 50V NP0 0805	4822 122 32636	S
C151	CAPACITOR 10 pF 5% 50V NP0 0805	2222 861 15109	S
C153	CAPACITOR 470 pF 1% 63V NP0 0805	5322 126 14051	S
C154	CAPACITOR 22 pF 5% 50V NP0 0805	5322 122 32658	S
C155	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C156	CAPACITOR 15 UF 20% 6.3V 6.0X3.2 MOLD	5322 124 11418	S
C157	CAPACITOR 15 UF 20% 6.3V 6.0X3.2 MOLD	5322 124 11418	S
C158	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C159	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C16	CAPACITOR 15 UF 20% 6.3V 6.0X3.2 MOLD	5322 124 11418	S
C160	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C161	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C162	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C163	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C164	CAPACITOR 2.20 UF 20%6.3V 3.2X1.6 MOLD	5322 124 10685	S
C165	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C166	CAPACITOR 15 UF 20% 6.3V 6.0X3.2 MOLD	5322 124 11418	S
C167	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C168	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C169	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C17	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C170	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C171	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C172	CAPACITOR 2.20 UF 20% 6.3V 3.2X1.6 MOLD	5322 124 10685	S
C173	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C174	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C175	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C176	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C177	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C178	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C179	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C18	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C180	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C181	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C182	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C183	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C184	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C185	CAPACITOR 15 UF 20% 6.3V 6.0X3.2 MOLD	5322 124 11418	S
C186	CAPACITOR 15 UF 20% 6.3V 6.0X3.2 MOLD	5322 124 11418	S
C19	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C2	CAPACITOR-TRIM 2.0-18 pF 300V	2222 809 05217	R
C20	CAPACITOR 1 nF 20% 50V X7R 0805	5322 122 34123	S
C21	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C22	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C23	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C24	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C25	CAPACITOR 10 pF 5% 50V NP0 0805	2222 861 15109	S
C26	CAPACITOR 10 pF 5% 50V NP0 0805	2222 861 15109	S
C27	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C28	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C29	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C3	CAPACITOR 22 nF 10% 200V X7R 1206	5322 126 14081	R
C30	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C31	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C32	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C33	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C34	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C35	CAPACITOR 470 nF 10% 25V X7R 1210	4822 126 12549	S
C36	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C37	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C38	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C39	CAPACITOR 6.80 UF 20% 16V 6.0X3.2 MOLD	5322 124 10687	R
C4	CAPACITOR 3.3 pF ±0.25pF 50V NP0 0805	2222 861 15338	S
C40	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C41	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S

Pos	Description	Part No.	☆
C42	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C43	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C44	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C45	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C46	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C47	CAPACITOR 15 UF 20% 6.3V 6.0X3.2 MOLD	5322 124 11418	S
C48	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C49	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C5	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C50	CAPACITOR 2.20 UF 20% 6.3V 3.2X1.6 MOLD	5322 124 10685	S
C51	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C52	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C53	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C54	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C55	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C56	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C57	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C58	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C59	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C6	CAPACITOR 1 nF 20% 50V X7R 0805	5322 122 34123	S
C60	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C61	CAPACITOR 15 UF 20% 6.3V 6.0X3.2 MOLD	5322 124 11418	S
C62	CAPACITOR 2.20 nF PME289MA4220MR04	5322 121 43756	S
C63	CAPACITOR 2.20 nF PME289MA4220MR04	5322 121 43756	S
C64	CAPACITOR 270 µF 20% SMG 400V 25X45	5322 124 80334	S
C65	CAPACITOR 100 nF 20% 250V	2222 336 20104	S
C66	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C67	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C68	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C69	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C7	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C70	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C71	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C72	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C73	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C74	CAPACITOR 68 µF 20% 6.3V SOLID AL	5322 124 10455	S
C75	CAPACITOR 33 µF 20% 63V RADIAL 2M 6.3x11	2222 037 90074	S
C76	CAPACITOR 33 µF 20% 63V RADIAL 2M 6.3x11	2222 037 90074	S
C77	CAPACITOR 10 pF 5% 50V NP0 0805	2222 861 15109	S
C78	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C79	CAPACITOR 33 µF 20% 63V RADIAL 2M 6.3x11	2222 037 90074	S
C8	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C80	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C81	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C82	CAPACITOR 15 UF 20% 6.3V 6.0X3.2 MOLD	5322 124 11418	S
C83	CAPACITOR 15 UF 20% 6.3V 6.0X3.2 MOLD	5322 124 11418	S
C85	CAPACITOR 22 pF 5% 50V NP0 0805	5322 122 32658	S
C86	CAPACITOR 22 pF 5% 50V NP0 0805	5322 122 32658	S
C87	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C88	CAPACITOR 2.20 UF 20% 6.3V 3.2X1.6 MOLD	5322 124 10685	S
C89	CAPACITOR 100 pF 5% 50V NP0 0805	2222 861 15101	S
C9	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C90	CAPACITOR 100 pF 5% 50V NP0 0805	2222 861 15101	S
C91	CAPACITOR 15 UF 20% 6.3V 6.0X3.2 MOLD	5322 124 11418	S
C92	CAPACITOR 15 UF 20% 6.3V 6.0X3.2 MOLD	5322 124 11418	S
C93	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C94	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C95	CAPACITOR 100 nF 20% 25V X7R 0805	5322 126 13638	S
C96	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C97	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C98	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
C99	CAPACITOR 10 nF 20% 50V X7R 0805	5322 122 34098	S
D1	DIODE 0.10A BAT18 35V 1PF SOT23	5322 130 32076	S
D10	DIODE 1A SB140 40V DO41	5322 130 81917	S

Pos	Description	Part No.	☆
D12	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D13	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D14	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D15	DIODE BYD17G 400V 1.5A SOD87	9338 122 40701	R
D16	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D17	DIODE BYD17G 400V 1.5A SOD87	9338 122 40701	R
D18	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D19	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D2	DIODE 0.10A BAT18 35V 1PF SOT23	5322 130 32076	S
D21	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D22	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D23	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D24	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D25	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D26	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D3	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D4	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D5	DIODE 0.10A BAV99 SOT23	5322 130 34337	S
D6	DIODE 1A 1N4003/200 DO41	4822 130 31878	S
D7	DIODE 1A SB140 40V DO41	5322 130 81917	S
D8	DIODE 1A SB140 40V DO41	5322 130 81917	S
D9	BRIDGE RECTIFIER 2KBP08 2A 800V	5322 130 50474	S
F1	FUSE HOLDER 011 656 5X20mm	4822 256 30139	S
F1	FUSE 1.6A 5X20 T FST034.3119	4822 253 30024	S
J1	SOLDERING LUG 10.0X15/21 CU SN	4031 100 58390	P
J1	CONNECTOR-COAX BNC	5322 267 10004	S
J10	FLAT PIN 2.8mm E184/8 LESA SN BAND	5322 290 34064	S
J15	CONNECTOR 2 POL F095 SINGLE ROW	5322 265 44074	S
J15	CONNECTOR 2POL F095 JUMPER GREY	5322 263 50101	S
J16	CONNECTOR 2POL F095 JUMPER GREY	5322 263 50101	S
J16	CONNECTOR 3 POL F095 SINGLE ROW	5322 290 60445	S
J17	CABLE ASSY	5322 321 60669	R
J18	CONNECTOR 40 POL LOW PROFILE HEADER	5322 265 41051	S
J19	CONNECTOR 16 POL TMH-108-01-L-DW	5322 265 41013	S
J21	CONNECTOR 2POL F095 JUMPER GREY	5322 263 50101	S
J21	CONNECTOR 3 POL F095 SINGLE ROW	5322 290 60445	S
J22	CONNECTOR 2POL F095 JUMPER GREY	5322 263 50101	S
J22	CONNECTOR 3 POL F095 SINGLE ROW	5322 290 60445	S
J23	CONNECTOR 2POL F095 JUMPER GREY	5322 263 50101	S
J23	CONNECTOR 3 POL F095 SINGLE ROW	5322 290 60445	S
J24	CONNECTOR 10 POL 22-03-2101 4030-10A	5322 265 64028	S
J25	CONNECTOR 2POL F095 JUMPER GREY	5322 263 50101	S
J25	CONNECTOR 3 POL F095 SINGLE ROW	5322 290 60445	S
J29	CONNECTOR 2POL F095 JUMPER GREY	5322 263 50101	S
J29	CONNECTOR 3 POL F095 SINGLE ROW	5322 290 60445	S
J3	FLAT PIN 2.8mm E184/8 LESA SN BAND	5322 290 34064	S
J30	CONNECTOR 2POL F095 JUMPER GREY	5322 263 50101	S
J30	CONNECTOR 3 POL F095 SINGLE ROW	5322 290 60445	S
J32	CONNECTOR 20 POL LOW PROFILE HEADER	5322 265 51296	S
J4	FLAT PIN 2.8mm E184/8 LESA SN BAND	5322 290 34064	S
J5	FLAT PIN 2.8mm E184/8 LESA SN BAND	5322 290 34064	S
J6	FLAT PIN 2.8mm E184/8 LESA SN BAND	5322 290 34064	S
J7	CONNECTOR 2 POL F095 SINGLE ROW	5322 265 44074	S
J9	FLAT PIN 2.8mm E184/8 LESA SN BAND	5322 290 34064	S
K1	RELAY REED 5V PRMA-15157-3790	5322 280 20489	R
K2	RELAY REED 5V PRMA-15157-3790	5322 280 20489	R
K3	RELAY REED 5V PRMA-15157-3790	5322 280 20489	R
K4	RELAY TQ2-5 SV/1A 2pol vx 14X9X5m	5322 280 20514	R
K5	RELAY 2p vx V23042-A1003-B101 (alt.A2303)	5322 280 60557	R
L1	CHOKE 220 UH 10% NL453232T-221K	5322 157 61918	S
L10	FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm	2422 549 43133	P
L11	FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm	2422 549 43133	P

Pos	Description	Part No.	☆
L12	FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm	2422 549 43133	P
L13	CHOKE 4.70µH 5% LQH1N4R7J	2422 535 94048	P
L14	FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm	2422 549 43133	P
L15	FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm	2422 549 43133	P
L16	FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm	2422 549 43133	P
L17	FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm	2422 549 43133	P
L18	FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm	2422 549 43133	P
L19	FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm	2422 549 43133	P
L2	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	P
L20	FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm	2422 549 43133	P
L21	FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm	2422 549 43133	P
L22	FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm	2422 549 43133	P
L23	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	P
L24	FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm	2422 549 43133	P
L25	FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm	2422 549 43133	P
L3	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L4	FILTER-EMI BLM21A102SPT Z=1Kohm 0.2A R=0.6ohm	2422 549 43133	P
L5	CHOKE 4S2 3.5X6MM BANDAD 80ohm at 100MHz	5322 157 61928	S
L6	CHOKE 10mH B82722-J2102-N1 1A	5322 157 70143	S
L7	CHOKE 10.00µH NEWPORT 18R103	2422 536 00061	P
L8	CHOKE 10.00µH NEWPORT 18R103	2422 536 00061	P
L9	CHOKE 33µH TSL0809-330K1R2	5322 157 53568	S
Q1	TRANSISTOR BF513 .03A20V SOT23	4822 130 60686	S
Q10	TRANSISTOR 0.5A BC807-25 45V SOT23	5322 130 60845	S
Q11	TRANSISTOR 0.5A BC817-25 45V SOT23	4822 130 42804	S
Q12	TRANSISTOR BC847B .1A45V SOT23	4822 130 60511	S
Q13	TRANSISTOR BFG97 0.1A 15V SO223	4822 130 63069	S
Q14	TRANSISTOR BC847B .1A45V SOT23	4822 130 60511	S
Q15	TRANSISTOR BC857B .1A45V SOT23	5322 130 60508	S
Q16	TRANSISTOR BC847B .1A45V SOT23	4822 130 60511	S
Q17	TRANSISTOR 0.5A BC817-25 45V SOT23	4822 130 42804	S
Q2	TRANSISTOR 25 MA BFR92A 20V SOT23	5322 130 60647	S
Q24	TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W	9340 022 10701	R
Q27	TRANSI-NPN SMD BFG16A SOT223 1.5GHz 1W	9340 022 10701	R
Q28	TRANSISTOR BFT92 25MA 15V SOT23	5322 130 44711	S
Q29	TRANSISTOR BFS17 .05A 15V SOT23	5322 130 40781	S
Q3	TRANSISTOR BFS17 .05A 15V SOT23	5322 130 40781	S
Q30	TRANSISTOR BFT92 25MA 15V SOT23	5322 130 44711	S
Q31	TRANSISTOR BFS17 .05A 15V SOT23	5322 130 40781	S
Q32	TRANSISTOR BFS17 .05A 15V SOT23	5322 130 40781	S
Q33	TRANSISTOR BFS17 .05A 15V SOT23	5322 130 40781	S
Q34	TRANSISTOR BFS17 .05A 15V SOT23	5322 130 40781	S
Q35	TRANSISTOR BFS17 .05A 15V SOT23	5322 130 40781	S
Q36	TRANSISTOR BSR12 0.1A 15V SOT23	5322 130 44743	S
Q37	TRANSISTOR BSR12 0.1A 15V SOT23	5322 130 44743	S
Q38	TRANSISTOR BFS17 .05A 15V SOT23	5322 130 40781	S
Q39	TRANSISTOR BFS17 .05A 15V SOT23	5322 130 40781	S
Q4	TRANSI-HF N SMD BFR93A 35mA 12V SOT23	5322 130 60705	S
Q5	TRANSISTOR BCP51 1.5A 45V SOT223	5322 130 62639	S
Q6	TRANSISTOR BC847B .1A45V SOT23	4822 130 60511	S
Q7	TRANSISTOR 0.5A BC807-25 45V SOT23	5322 130 60845	S
R1	RESISTOR 47 ohm 1% 0.125W 100PPM 1206	5322 116 80448	S
R10	RESISTOR 120 ohm 1% 0.125W 100PPM 1206	4822 051 10121	S
R100	RESISTOR 27 ohm 1% 0.1W 100PPM 0805	4031 002 27090	S

Pos	Description	Part No.	☆
R101	RESISTOR 4.7 kohm 1% 0.125W 100PPM 1206	4822 051 54702	S
R105	RESISTOR 1.00 kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R106	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R107	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R108	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R109	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R11	RESISTOR 120 ohm 1% 0.125W 100PPM 1206	4822 051 10121	S
R110	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R111	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R112	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R113	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R115	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R116	RESISTOR 15.0 kohm 1% .125W 100PPM 1206	5322 116 82261	S
R117	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R118	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R119	RESISTOR 1.00 kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R12	RESISTOR 120 ohm 1% 0.125W 100PPM 1206	4822 051 10121	S
R121	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R122	RESISTOR 100 kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R123	RESISTOR 100 kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R124	RESISTOR 100 kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R125	RESISTOR 100 kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R126	RESISTOR 1.00 kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R127	RESISTOR 1.00 Mohm 1% 0.125W 100PPM 1206	4822 051 10105	S
R128	RESISTOR 1.50 kohm 1% 0.125W 100PPM 1206	4822 051 51502	S
R129	RESISTOR 470 ohm 1% .125W 100PPM 1206	4822 051 54701	S
R13	RESISTOR 120 ohm 1% 0.125W 100PPM 1206	4822 051 10121	S
R130	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R131	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R132	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R133	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R134	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R135	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R136	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R137	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R138	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R139	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R14	RESISTOR 120 ohm 1% 0.125W 100PPM 1206	4822 051 10121	S
R140	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R141	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R142	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R143	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R144	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R145	RESISTOR 330 ohm 1% .125W 100PPM 1206	4822 051 53301	S
R146	RESISTOR 15.0 kohm 1% .125W 100PPM 1206	5322 116 82261	S
R147	RESISTOR 2.20 kohm 1% .125W 100PPM 1206	4822 051 52202	S
R148	THERMISTOR 16.0 Ω 20% 3.5A S236/16	5322 116 30457	S
R149	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R15	RESISTOR 150 ohm 1% 0.125W 100PPM 1206	4822 051 51501	S
R150	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R151	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R152	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R153	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R154	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R155	RESISTOR 330 ohm 1% .125W 100PPM 1206	4822 051 53301	S
R158	RESISTOR 120 ohm 1% 0.1W 100PPM 0805	5322 117 12506	S
R159	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R16	RESISTOR 150 ohm 1% 0.125W 100PPM 1206	4822 051 51501	S
R160	RESISTOR 390 ohm 1% .125W 100PPM 1206	4822 051 53901	S
R161	RESISTOR 100 kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R162	RESISTOR 100 kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R163	RESISTOR 100 kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R164	RESISTOR 100 kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R165	RESISTOR 100 kohm 1% 0.125W 100PPM 1206	4822 051 51004	S

Pos	Description	Part No.	☆
R166	RESISTOR 100 kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R167	RESISTOR 100 kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R168	RESISTOR 100 kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R169	RESISTOR 100 kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R17	RESISTOR 27.0 ohm 1% .125W 100PPM 1206	5322 116 82262	S
R170	RESISTOR 2.20 kohm 1% .125W 100PPM 1206	4822 051 52202	S
R171	RESISTOR 2.20 kohm 1% .125W 100PPM 1206	4822 051 52202	S
R172	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R173	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R174	RESISTOR 330 ohm 1% .125W 100PPM 1206	4822 051 53301	S
R175	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R176	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R177	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R178	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R179	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R18	RESISTOR 68.0 kohm 1% .125W 100PPM 1206	4822 051 56803	S
R180	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R181	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R182	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	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 22.0 kohm 1% .125W 100PPM 1206	4822 051 52203	S
R190	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R191	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R193	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R194	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R195	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R196	RESISTOR 120 ohm 1% 0.1W 100PPM 0805	5322 117 12506	S
R197	RESISTOR 120 ohm 1% 0.1W 100PPM 0805	5322 117 12506	S
R198	RESISTOR 4.70 kohm 1% .125W 100PPM 1206	4822 051 54702	S
R199	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R2	RESISTOR 100 ohm 1% 0.125W 100PPM 1206	4822 051 51001	S
R20	RESISTOR 8.20 kohm 1% .125W 100PPM 1206	4822 051 10822	S
R200	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R201	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R202	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R203	RESISTOR 560 ohm 1% .125W 100PPM 1206	4822 051 10561	S
R204	RESISTOR 2.20 kohm 1% .125W 100PPM 1206	4822 051 52202	S
R205	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R206	RESISTOR 5.60 kohm 1% .125W 100PPM 1206	4822 051 10562	S
R207	RESISTOR 1.00 kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R209	RESISTOR 560 ohm 1% .125W 100PPM 1206	4822 051 10561	S
R21	RESISTOR 15.0 ohm 1% .125W 100PPM 1206	4822 051 10159	S
R211	RESISTOR 1.00 Mohm 1% 0.125W 100PPM 1206	4822 051 10105	S
R217	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R218	RESISTOR 680 ohm 1% .125W 100PPM 1206	4822 051 56801	S
R219	RESISTOR 330 kohm 1% .125W 100PPM 1206	5322 117 10969	S
R22	RESISTOR 220 kohm 1% .125W 100PPM 1206	4822 051 52204	S
R220	SENSOR-TEMP KTY82/120	5322 130 10682	S
R222	RESISTOR 180 kohm 1% .125W 100PPM 1206	4822 051 51804	S
R23	RESISTOR 220 kohm 1% .125W 100PPM 1206	4822 051 52204	S
R230	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R233	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R235	RESISTOR 120 ohm 1% 0.1W 100PPM 0805	5322 117 12506	S
R24	RESISTOR 470 kohm 1% .125W 100PPM 1206	5322 116 80447	S
R241	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R242	RESISTOR 680 ohm 1% 0.125W 100PPM 1206	4822 051 56801	S
R243	RESISTOR 18.0 kohm 1% .125W 100PPM 1206	5322 117 10034	S
R244	RESISTOR 82 ohm 1% .125W 100PPM 1206	4822 051 10829	S

Pos	Description	Part No.	☆
R245	RESISTOR 3.90 kohm 1% .125W 100PPM 1206	4822 051 53902	S
R247	RESISTOR 820 ohm 1% .125W 100PPM 1206	5322 116 82264	S
R248	RESISTOR 680 ohm 1% .125W 100PPM 1206	4822 051 56801	S
R249	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R25	RESISTOR 470 kohm 1% .125W 100PPM 1206	5322 116 80447	S
R251	RESISTOR 1.00 kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R252	RESISTOR 100 ohm 1% .125W 100PPM 1206	4822 051 51001	S
R253	RESISTOR 560 ohm 1% 0.125W 100PPM 1206	4822 051 10561	S
R254	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R255	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R258	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R259	RESISTOR 680 ohm 1% .125W 100PPM 1206	4822 051 56801	S
R26	RESISTOR 470 kohm 1% .125W 100PPM 1206	5322 116 80447	S
R260	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R261	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R262	RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206	4822 051 10109	S
R263	RESISTOR 1.00 kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R264	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R265	RESISTOR 1.00 kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R266	RESISTOR 1.00 kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R267	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R268	RESISTOR 1.00 kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R269	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R27	RESISTOR 470 kohm 1% .125W 100PPM 1206	5322 116 80447	S
R270	RESISTOR 8.20 kohm 1% .125W 100PPM 1206	4822 051 10822	S
R271	RESISTOR 820 ohm 1% .125W 100PPM 1206	5322 116 82264	S
R272	RESISTOR 2.20 kohm 1% .125W 100PPM 1206	4822 051 52202	S
R273	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R274	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R275	RESISTOR 2.20 kohm 1% .125W 100PPM 1206	4822 051 52202	S
R276	RESISTOR 33.0 kohm 1% .125W 100PPM 1206	4822 051 53303	S
R277	RESISTOR 33.0 kohm 1% .125W 100PPM 1206	4822 051 53303	S
R278	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R279	RESISTOR 8.20 kohm 1% .125W 100PPM 1206	4822 051 10822	S
R28	RESISTOR 470 kohm 1% .125W 100PPM 1206	5322 116 80447	S
R280	RESISTOR 820 ohm 1% .125W 100PPM 1206	5322 116 82264	S
R281	RESISTOR 2.20 kohm 1% .125W 100PPM 1206	4822 051 52202	S
R282	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R283	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R284	RESISTOR 2.20 kohm 1% .125W 100PPM 1206	4822 051 52202	S
R285	RESISTOR 33.0 kohm 1% .125W 100PPM 1206	4822 051 53303	S
R286	RESISTOR 33.0 kohm 1% .125W 100PPM 1206	4822 051 53303	S
R287	RESISTOR 0 ohm JUMPER RC-01 1206	4822 051 10008	S
R288	RESISTOR 68 ohm 1% .125W 100PPM 1206	4822 051 10689	S
R288	RESISTOR 33.0 ohm 1% .125W 100PPM 1206	4822 051 10339	S
R289	RESISTOR 220 ohm 1% 0.1W 100PPM 0805	4031 002 22010	S
R29	RESISTOR 22.0 kohm 1% .125W 100PPM 1206	4822 051 52203	S
R290	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R291	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R292	RESISTOR 0 ohm JUMPER RC-01 1206	4822 051 10008	S
R293	RESISTOR 330 ohm 1% .125W 100PPM 1206	4822 051 53301	S
R294	RESISTOR 27 ohm 1% 0.1W 100PPM 0805	4031 002 27090	S
R295	RESISTOR 270 ohm 1% .125W 100PPM 1206	4822 051 10271	S
R296	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R297	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R298	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R3	RESISTOR 470 kohm 1% .125W 100PPM 1206	5322 116 80447	S
R30	RESISTOR 470 kohm 1% .125W 100PPM 1206	5322 116 80447	S
R300	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R301	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R302	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R303	RESISTOR 27 ohm 1% 0.1W 100PPM 0805	4031 002 27090	S
R304	RESISTOR 120 ohm 1% 0.1W 100PPM 0805	5322 117 12506	S
R305	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S

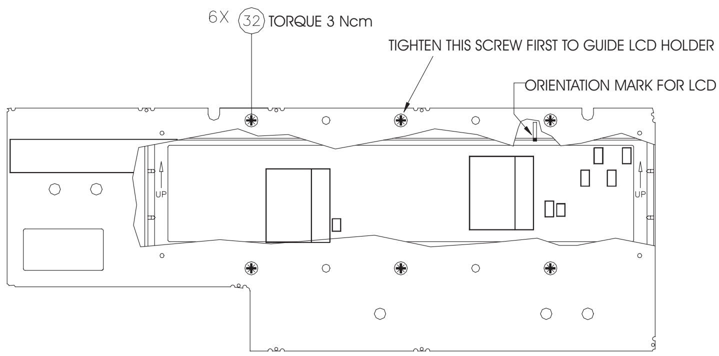
Pos	Description	Part No.	☆
R306	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R307	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R309	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R31	POTENTIOMETER 100 kohm 3304X-1-104	5322 101 10841	S
R310	RESISTOR 27 ohm 1% 0.1W 100PPM 0805	4031 002 27090	S
R311	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R312	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R313	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R314	RESISTOR 120 ohm 1% 0.1W 100PPM 0805	5322 117 12506	S
R315	RESISTOR 820 ohm 1% .125W 100PPM 1206	5322 116 82264	S
R316	RESISTOR 2.20 kohm 1% .125W 100PPM 1206	4822 051 52202	S
R317	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R318	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R319	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R32	RESISTOR 470 kohm 1% .125W 100PPM 1206	5322 116 80447	S
R320	RESISTOR 56 ohm 1% .125W 100PPM 1206	4822 051 10569	S
R321	RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206	4822 051 10109	S
R322	RESISTOR 10.0 ohm 1% 0.125W 100PPM 1206	4822 051 10109	S
R323	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R325	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R326	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R327	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R328	RESISTOR 27 ohm 1% 0.1W 100PPM 0805	4031 002 27090	S
R329	RESISTOR 120 ohm 1% 0.1W 100PPM 0805	5322 117 12506	S
R33	POTENTIOMETER 10 kohm 3304X-1-103	5322 100 11143	S
R330	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R331	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R34	RESISTOR 18.0 kohm 1% .125W 100PPM 1206	5322 117 10034	S
R35	RESISTOR 470 ohm 1% .125W 100PPM 1206	4822 051 54701	S
R36	RESISTOR 470 ohm 1% .125W 100PPM 1206	4822 051 54701	S
R37	RESISTOR 1.50 kohm 1% 0.125W 100PPM 1206	4822 051 51502	S
R38	RESISTOR 1.00 kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R39	RESISTOR 10 MOHM 10% 0.25W RC-01 1206	4822 051 10106	S
R4	RESISTOR 220 kohm 1% .125W 100PPM 1206	4822 051 52204	S
R40	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R41	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R42	RESISTOR 15.0 ohm 1% .125W 100PPM 1206	4822 051 10159	S
R43	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R44	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R45	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R46	RESISTOR 150 ohm 1% 0.125W 100PPM 1206	4822 051 51501	S
R47	RESISTOR 150 ohm 1% 0.125W 100PPM 1206	4822 051 51501	S
R48	RESISTOR 82 ohm 1% .125W 100PPM 1206	4822 051 10829	S
R49	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R5	RESISTOR 220 kohm 1% .125W 100PPM 1206	4822 051 52204	S
R50	RESISTOR 8.2 ohm 10% 0.25W RC-01 1206	4822 051 10828	S
R51	RESISTOR 2.70 kohm 1% .125W 100PPM 1206	4822 051 52702	S
R53	RESISTOR 2.20 kohm 1% .125W 100PPM 1206	4822 051 52202	S
R54	RESISTOR 560 ohm 1% .125W 100PPM 1206	4822 051 10561	S
R55	RESISTOR 560 ohm 1% .125W 100PPM 1206	4822 051 10561	S
R56	RESISTOR 390 ohm 1% .125W 100PPM 1206	4822 051 53901	S
R57	RESISTOR 15.0 kohm 1% .125W 100PPM 1206	5322 116 82261	S
R58	RESISTOR 120 ohm 1% 0.125W 100PPM 1206	4822 051 10121	S
R6	RESISTOR 47 ohm 1% .125W 100PPM 1206	5322 116 80448	S
R60	RESISTOR 4.70 kohm 1% .125W 100PPM 1206	4822 051 54702	S
R61	RESISTOR 220.0 ohm 1% .125W 100PPM 1206	4822 051 52201	S
R63	RESISTOR 6.80 kohm 1% .125W 100PPM 1206	4822 051 10682	S
R64	RESISTOR 1.00 kohm 1% 0.125W 100PPM 1206	4822 051 51002	S
R65	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R66	RESISTOR 4.70 kohm 1% .125W 100PPM 1206	4822 051 54702	S
R67	RESISTOR 2.20 kohm 1% .125W 100PPM 1206	4822 051 52202	S
R69	POTENTIOMETER 100 kohm 3304X-1-104	5322 101 10841	S
R7	RESISTOR 120 ohm 1% 0.125W 100PPM 1206	4822 051 10121	S
R70	POTENTIOMETER 100 kohm 3304X-1-104	5322 101 10841	S

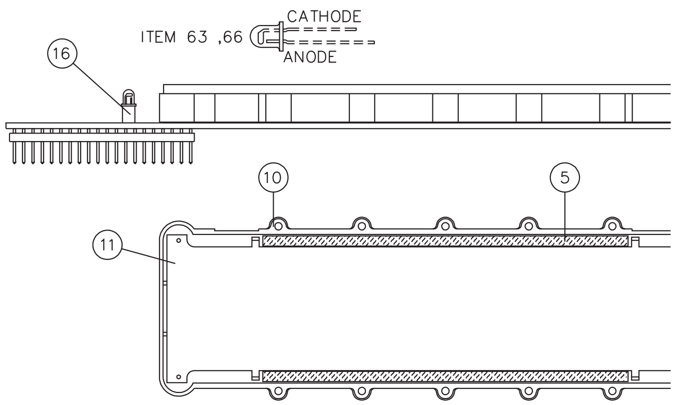
Pos	Description	Part No.	☆
R71	RESISTOR 100 kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R72	RESISTOR 100 kohm 1% 0.125W 100PPM 1206	4822 051 51004	S
R73	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R74	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R75	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R76	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R77	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R78	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R79	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R8	RESISTOR 120 ohm 1% 0.125W 100PPM 1206	4822 051 10121	S
R80	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R81	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R82	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R83	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R84	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R85	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R86	RESISTOR 10.0 kohm 1% 0.125W 100PPM 1206	4822 051 51003	S
R87	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R88	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R89	RESISTOR 68 ohm 1% .125W 100PPM 1206	4822 051 10689	S
R9	RESISTOR 120 ohm 1% 0.125W 100PPM 1206	4822 051 10121	S
R90	RESISTOR 68 ohm 1% .125W 100PPM 1206	4822 051 10689	S
R91	POTENTIOMETER 100ohm CVR-4A-101	5322 101 10989	S
R92	RESISTOR 8.20 kohm 1% .125W 100PPM 1206	4822 051 10822	S
R93	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R94	RESISTOR 47 ohm 1% 0.1W 100PPM 0805	5322 117 12505	S
R95	RESISTOR 3.30 kohm 1% .125W 100PPM 1206	4822 051 53302	S
R96	RESISTOR 1.80 kohm 1% .125W 100PPM 1206	4822 051 10182	S
R98	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
R99	RESISTOR 100 ohm 1% 0.1W 100PPM 0805	5322 117 12497	S
U1	IC-OP AMP CA3140AM CA3140 AM BIMOS SO8	9322 114 39682	R
U10	IC-ANA TL7705BCD SMD LOW VOLT DETECT	5322 209 90426	R
U11	IC MICROP N80C196KB10	5322 209 52203	R
U12	IC-PROM 24LC16B 16kBIT I2C SMD SO8	9322 186 14682	P
U13	IC PC74HC574T SO20	4822 209 60451	S
U14	IC PC74HC573T SO20	5322 209 60424	S
U15	IC PC74HC02T SO-14	5322 209 71563	S
U16	IC PC74HC573T SO20	5322 209 60424	S
U17	IC PC74HC573T SO20	5322 209 60424	S
U18	IC PC74HC21T SO14	5322 209 60437	S
U19	IC PC74HC00T SO14	5322 209 71802	S
U2	IC PC74HC574T SO20	4822 209 60451	S
U20	IC PC74HC138T SO16	5322 209 73178	S
U21	IC NE532D DUAL SO-8	5322 209 71553	R
U22	IC-SRAM TC55257DFL-85L SOP28 32Kx8	9322 106 65682	R
U23	IC-PROM PM6685 27C512	5322 209 31776	P
U23	IC SOCKET 32 POL P/N 213-032-602	5322 255 41141	S
U24	IC PC74HC32T SO14	4822 209 63475	S
U25	IC PC74HC32T SO14	4822 209 63475	S
U26	IC-CMOS 74HC10 SO14 SO-14	9337 142 80653	S
U27	IC-DIG ECL 100331QC 3XDFLIP-FLOP PCC28	5322 209 33604	S
U28	IC-BUS TRANSCEIV 75ALS176D SO-8 SMD	5322 209 33171	R
U29	IC-ASIC	5322 209 90513	R
U3	IC PC74HC4353T SO20	4822 209 62805	S
U30	IC PC74HC00T SO14	5322 209 71802	S
U31	IC-OMV ADC 10BIT ADC1061C1WM SO20	9322 187 55682	R
U32	IC PC74HC573T SO20	5322 209 60424	S
U34	IC PC74HC00T SO14	5322 209 71802	S
U35	IC-OMV ADC 10BIT ADC1061C1WM SO20	9322 187 55682	R
U36	IC PC74HC573T SO20	5322 209 60424	S
U38	IC NE532D DUAL SO-8	5322 209 71553	S
U39	POWER MODULE	5322 693 22828	R
U4	IC 8 BIT PM7528HPC PLCC20	4822 209 62803	S
U40	IC HEF4013BT SO14	5322 209 14477	S

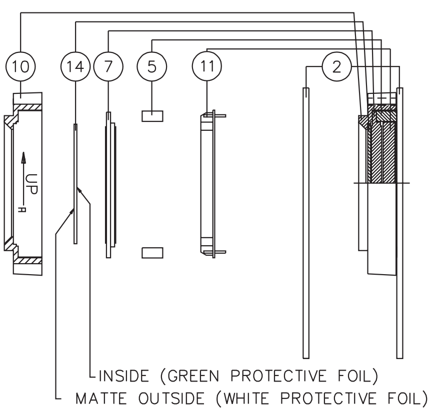
Pos	Description	Part No.	☆
U41	INSULAT.PLATEP TO220 CLIP Sil-Pad 400AC	5322 466 61813	P
U41	CLAMP TO220	5322 401 11257	P
U41	IC 12V LM2940CT-12 TO220	4822 209 62085	S
U43	INSULAT.PLATEP TO220 CLIP Sil-Pad 400AC	5322 466 61813	S
U43	CLAMP TO220	5322 401 11257	P
U43	IC 1.50 A LM337T TO-220	5322 209 81236	S
U44	IC-CMOS 74HC125 SMD SO14	9337 569 90701	S
U5	IC NE532D DUAL SO-8	5322 209 71553	S
U50	IC-COMP MAX961 SO8 4.5ns	9322 194 34682	R
U6	IC NE532D DUAL SO-8	5322 209 71553	S
U7	IC NE532D DUAL SO-8	5322 209 71553	S
U8	IC-COMP AD96687BP PLCC20	4822 201 62795	R
U9	IC-DIG ECLIPS MC10E104	4822 209 31775	R

Front Board

Pos	Description	Part Number	☆
5	Connector row, SG0.25x100x6.0x3.0	5322 267 70294	R
7	LCD Display	5322 214 91033	R
10	LCD bezel	4031 100 62820	R
11	Backlight-LED	5322 130 82201	R
14	Window LCD	5322 381 11136	P
16	LED spacer, LEDS1E-3-01 for led	5322 255 41228	P
20	Rubber keypad	4031 100 62720	R
32	Screw, RX-PT Z 2-28X8 FZB	4822 502 30081	P
C201	Capacitor 10 nF 20% 50V X7R, 0805	5322 122 34098	S
C202	Capacitor 10 nF 20% 50V X7R, 0805	5322 122 34098	S
D201	LED 3 mm HLMP-1300 red	5322 130 81921	R
D202	LED 3mm Yellow 590nm 4-8MCD/10mA	4822 130 30953	R
P204	Connector 40 POL TMH-120-01-L-DW	5322 265 51295	P
R201	Resistor 220 k 1% .125W 100PPM 1206	4822 051 52204	S
R204	Resistor, 10.0 Ω 1% 0.125W 1206	4822 051 10109	S
R205	Resistor, 10.0 Ω 1% 0.125W 1206	4822 051 10109	S
R206	Resistor, 10.0 Ω 1% 0.125W 1206	4822 051 10109	S
R207	Resistor, 10.0 Ω 1% 0.125W 1206	4822 051 10109	S
U201	IC, PCF8576T, VSO56	5322 209 11129	R
U202	IC, PCF8576T, VSO56	5322 209 11129	R







GPIB Interface (PM9626B)

Pos	Description	Part Number	☆
	Connector, KC-79-35	5322 267 10004	S
	IC-Socket, 40pin, DIL	5322 255 44217	S
	Lock Washer, YT3.2 ST FZ DIN6798A	4822 530 80082	P
	Screw, MRT-KOMBI 3X08, STFZ	5322 502 21489	P
	Screw, MRT-KOMBI 3X10, STFZ	5322 502 21644	P
	Spring Washer, KBA 3.2 ST FZ DIN137	4822 530 80173	P
BU101	Cable Assy	5322 321 61341	P
BU103	Connector 24pin 57LE-20240-77OOD35G	5322 267 60148	P
C101	Capacitor 10 nF 20% 50V X7R 0805	5322 122 34098	S
C102	Capacitor 10 nF 20% 50V X7R 0805	5322 122 34098	S
C103	Capacitor 10 nF 20% 50V X7R 0805	5322 122 34098	S
C104	Capacitor 220 pF 5% 50V NP0 0805	4822 122 33575	S
C105	Capacitor 100 nF 10% 63V X7R 1206	4822 122 33496	S
C106	Capacitor 10 nF 20% 50V X7R 0805	5322 122 34098	S
C107	Capacitor 10 nF 20% 50V X7R 0805	5322 122 34098	S
C108	Capacitor 10 nF 20% 50V X7R 0805	5322 122 34098	S
C109	Capacitor 10 nF 20% 50V X7R 0805	5322 122 34098	S
C110	Capacitor 10 nF 20% 50V X7R 0805	5322 122 34098	S
C111	Capacitor 10 nF 20% 50V X7R 0805	5322 122 34098	S
C112	Capacitor 10 nF 20% 50V X7R 0805	5322 122 34098	S
C113	Capacitor 10 nF 20% 50V X7R 0805	5322 122 34098	S
C114	Capacitor 10 nF 20% 50V X7R 0805	5322 122 34098	S
C115	Capacitor 10 nF 20% 50V X7R 0805	5322 122 34098	S
C116	Capacitor 10 nF 20% 50V X7R 0805	5322 122 34098	S
C117	Capacitor 10 nF 20% 50V X7R 0805	5322 122 34098	S
C118	Capacitor 68 µF 20% 6.3V SOLID AL	5322 124 10455	S
IC101	IC PC74HC32T SO14	4822 209 63475	S
IC103	IC NE532D DUAL SO-8	5322 209 71553	R
IC106	IC PC74HC00T SO14	5322 209 71802	S
IC107	IC PC74HC573T SO20	5322 209 60424	S
IC108	IC PC74HC573T SO20	5322 209 60424	S
IC109	IC socket 32pin P/N 213-032-602	5322 255 41141	S
IC109	IC-PROM PM9626B	5322 209 51853	R
IC111	IC-SRAM TC55257DFL-85L SOP28 32Kx8	9322 106 65682	R
IC113	IC-DIG UPD7210D IEC BUS GPIB CONTROLLER	9322 023 60682	R
IC114	IC SN75160AN	5322 209 81807	R
IC115	IC SN75161AN	5322 209 81842	R
IC116	IC PC74HC573T SO20	5322 209 60424	S
IC117	IC PC74HC86T SO-14	5322 209 71562	S
R101	Resistor 47 k 1% 1/8W 100PPM 1206	5322 116 80446	S
R102	Resistor 47 k 1% 1/8W 100PPM 1206	5322 116 80446	S
R103	Resistor 4.7 k 1% 1/8W 100PPM 1206	4822 051 54702	S
R104	Potentiometer 1k 3304X-1-102E	5322 101 11095	S
R105	Resistor 10 k 1% 1/8W 100PPM 1206	4822 051 51003	S
R106	Resistor 330 1% 1/8W 100PPM 1206	4822 051 53301	S
R107	Potentiometer 10 k 25% 0.1W 3304X-1-103	5322 100 11143	S
R108	Resistor 3.3 k 1% 1/8W 100PPM 1206	4822 051 53302	S
R109	Resistor 100 1% 1/8W 100PPM 1206	4822 051 51001	S
R110	Resistor 100 1% 1/8W 100PPM 1206	4822 051 51001	S
R111	Resistor 1 k 1% 1/8W 100PPM 1206	4822 051 51002	S
R112	Resistor 100 k 1% 1/8W 100PPM 1206	4822 051 51004	S
R113	Resistor 100 k 1% 1/8W 100PPM 1206	4822 051 51004	S
R114	Resistor 100 k 1% 1/8W 100PPM 1206	4822 051 51004	S
R115	Resistor 100 k 1% 1/8W 100PPM 1206	4822 051 51004	S
R116	Resistor 100 k 1% 1/8W 100PPM 1206	4822 051 51004	S
R117	Resistor 100 k 1% 1/8W 100PPM 1206	4822 051 51004	S
SK101	DIP switch 6-p 206-6 RAST	5322 277 21125	R

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Chapter 8

Drawings & Diagrams

How to read the diagrams

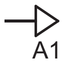
This chapter contains circuit diagrams and component layout.

Each diagram has been completed with lists of the ICs used in the unit. This list indicates the connections that are not shown in the diagram, such as GND and supply voltages.

Signals

The signals in these units 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.



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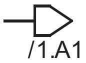

This arrow is used if the reference is directed to a point located on another page. The example means that the point is on sheet 1, coordinate A1.

Circuit symbols

The circuit diagrams are computer drawn. The symbols conform to the 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 it is a complex circuit, 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

"R305" is a typical component number. The "R" indicates that it is a resistor,"3" that it is positioned on the "unit 3", and 05 that it is the fifth resistor in the component list for that unit.

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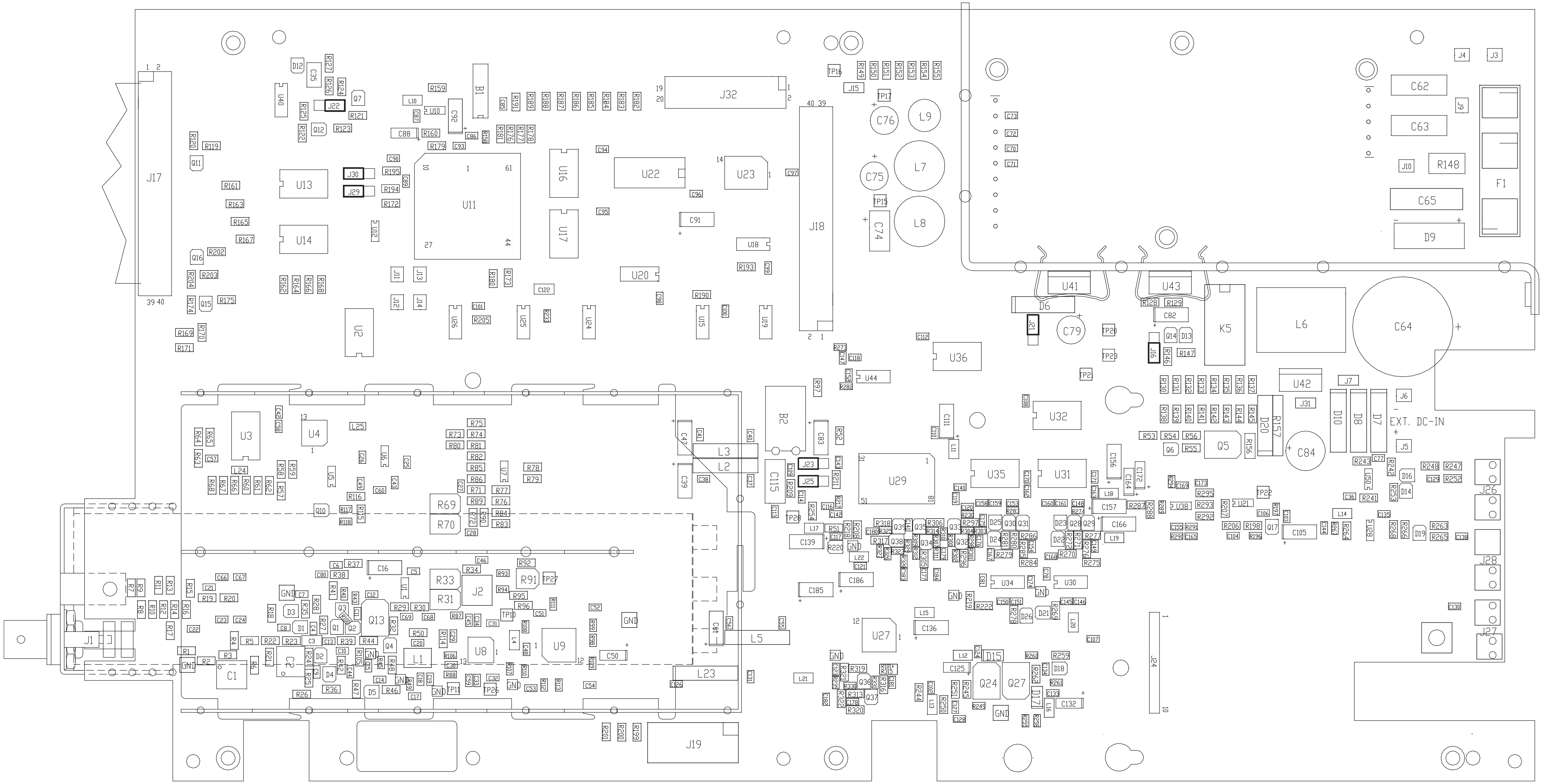
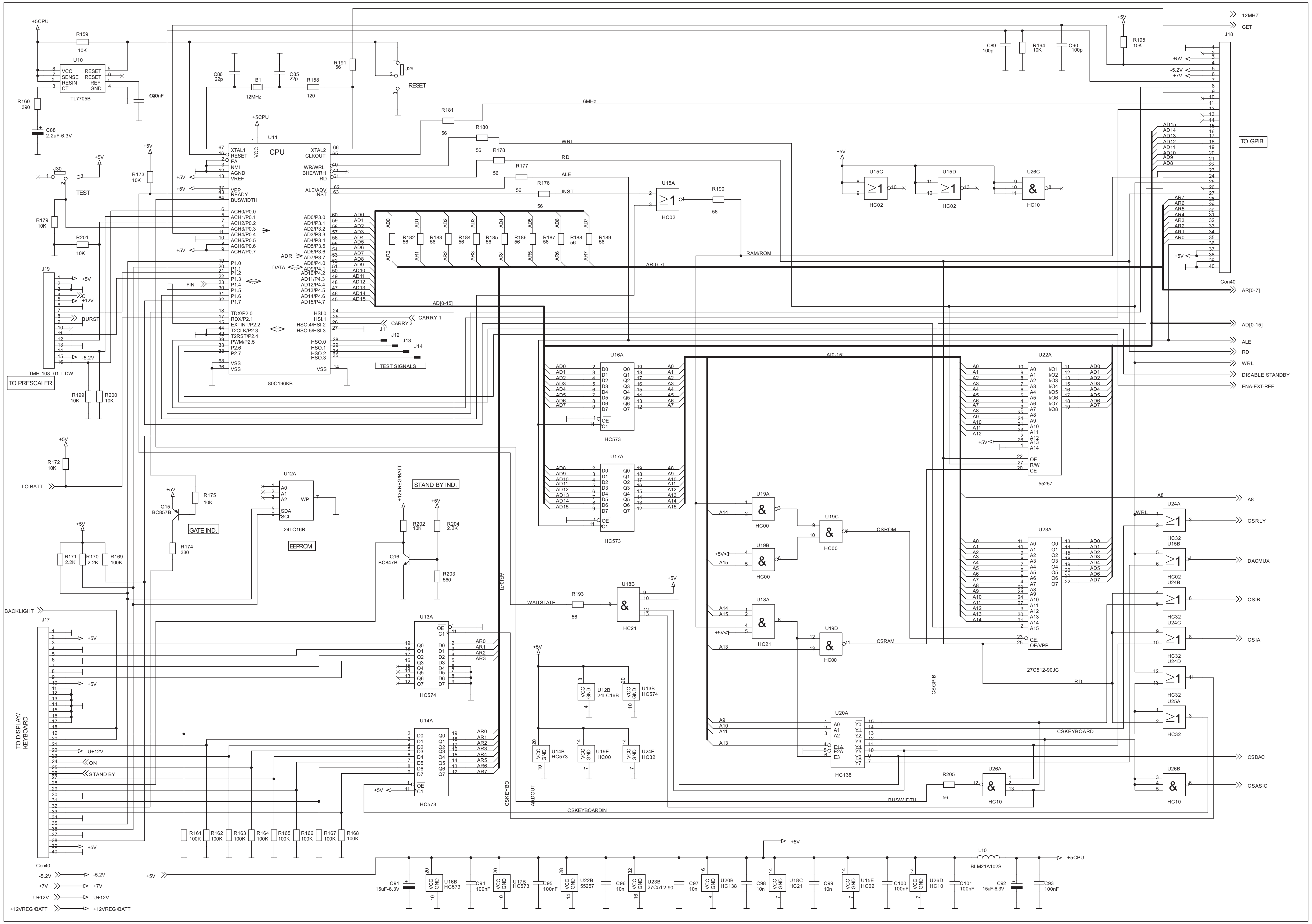
Main PCB, Component layout

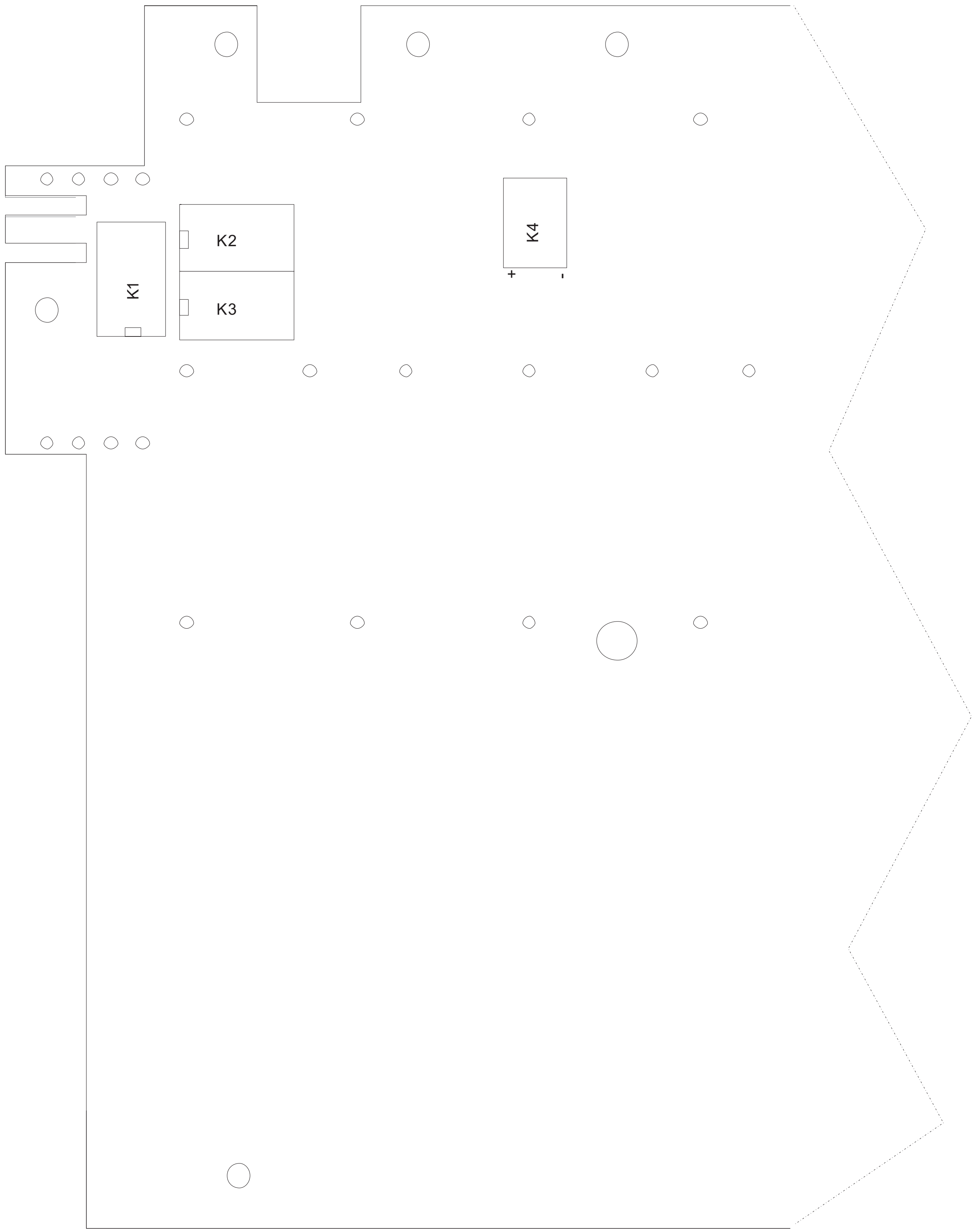


Top View

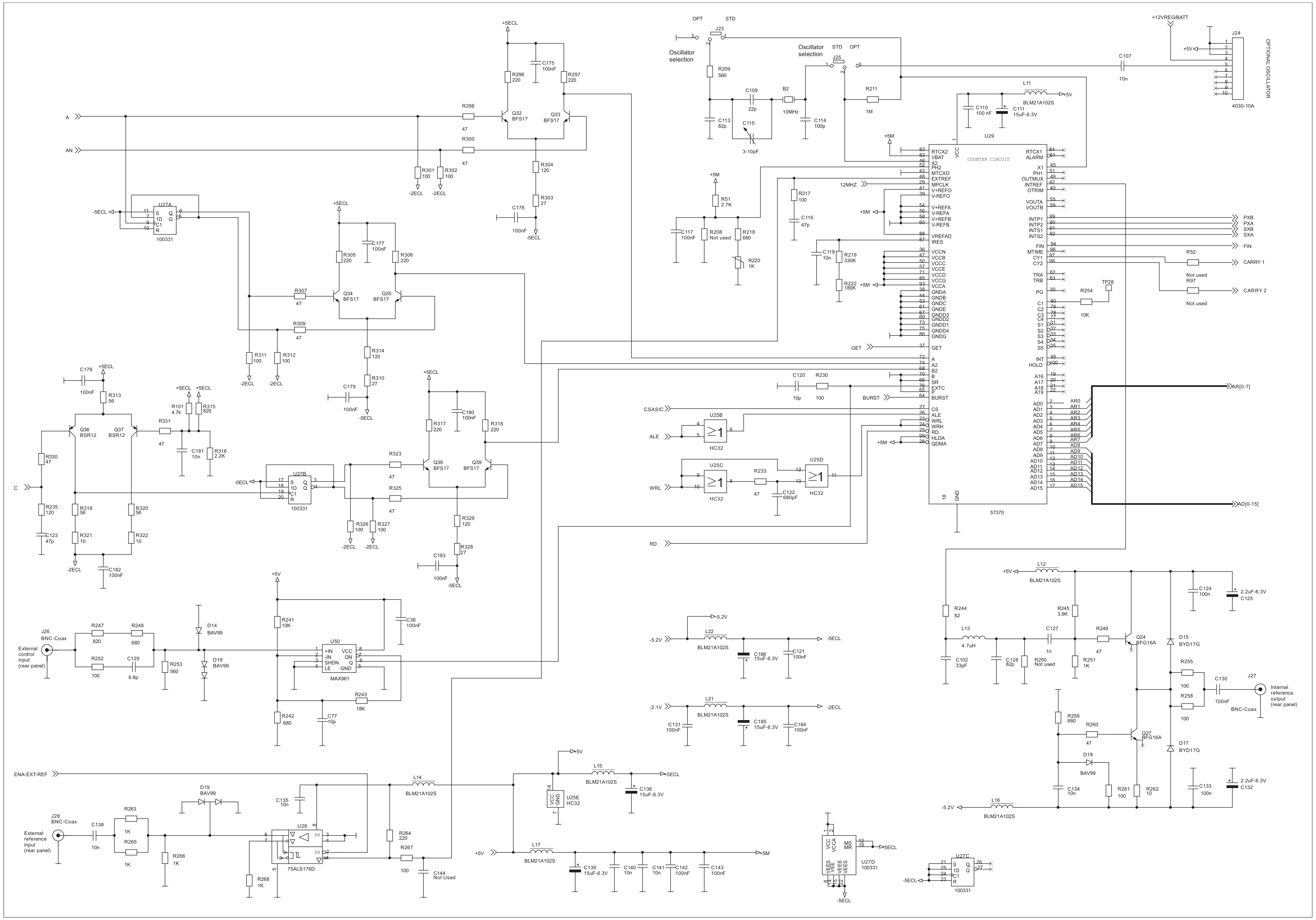
Control Logic, PCB 1, sheet 1(5)



Main PCB, Component layout



Bottom View



OPT
STD
J23
Oscillator selection
J25
R209 560
C109 22p
B2 10MHz
C113 82p
C115 3-10pF
C114 100p
R211 1M
L11 BLM21A102S
C110 100 nF
C111 15uF-6.3V
C107 10n
+12VREG/BATT
J24
4030-10A
OPTIONAL OSCILLATOR
U29
COUNTER CIRCUIT
57370
12MHZ
R51 2.7K
R217 100
C116 47p
C117 100nF
R208 Not used
R218 680
R220 1K
C119 10n
R219 330K
R222 180K
GET
C120 10p
R230 100
BURST
CSASIC
ALE
WRL
RD
U25B HC32
U25C HC32
U25D HC32
R233 47
C122 680pF
PXB
PXA
SXB
SXA
FIN
R52 Not used
R97 Not used
CARRY 1
CARRY 2
TP28
R254 10K
AR[0-7]
AD[0-15]
A
AN
R298 47
R300 47
Q32 BFS17
Q33 BFS17
R296 220
R297 220
C175 100nF
R301 100
R302 100
R304 120
R303 27
C176 100nF
U27A 100331
R305 220
R306 220
C177 100nF
R307 47
Q34 BFS17
Q35 BFS17
R309 47
R311 100
R312 100
R314 120
R310 27
C179 100nF
C178 100nF
R313 56
Q36 BSR12
Q37 BSR12
R331 47
R101 4.7k
R315 820
C181 10n
R316 2.2K
R330 47
C
R235 120
C123 47p
R319 56
R320 56
R321 10
R322 10
C182 100nF
U27B 100331
R323 47
R325 47
Q38 BFS17
Q39 BFS17
R317 220
R318 220
C180 100nF
R326 100
R327 100
R329 120
R328 27
C183 100nF
J26 BNC-Coax
External control input (rear panel)
R247 820
R248 680
R252 100
C129 6.8p
R253 560
D14 BAV99
D16 BAV99
R241 10K
U50 MAX961
C36 100nF
R243 18K
R242 680
C77 10p
ENA-EXT-REF
J28 BNC-Coax
External reference input (rear panel)
C138 10n
R263 1K
R265 1K
R266 1K
D19 BAV99
C135 10n
U28 75ALS176D
R268 1K
L14 BLM21A102S
R264 220
R267 100
C144 Not Used
L15 BLM21A102S
C136 15uF-6.3V
U25E HC32
L17 BLM21A102S
C139 15uF-6.3V
C140 10n
C141 10n
C142 100nF
C143 100nF
L22 BLM21A102S
C186 15uF-6.3V
C121 100nF
L21 BLM21A102S
C131 100nF
C185 15uF-6.3V
C184 100nF
U27D 100331
U27C 100331
L12 BLM21A102S
C124 100n
C125 2.2uF-6.3V
R244 82
R245 3.9K
L13 4.7uH
C127 1n
R249 47
Q24 BFG16A
D15 BYD17G
C102 33pF
C128 82p
R250 Not used
R251 1K
R255 100
R258 100
C130 100nF
J27 BNC-Coax
Internal reference output (rear panel)
R259 680
R260 47
Q27 BFG16A
D17 BYD17G
D18 BAV99
C134 10n
R261 100
R262 10
C133 100n
C132 2.2uF-6.3V
L16 BLM21A102S

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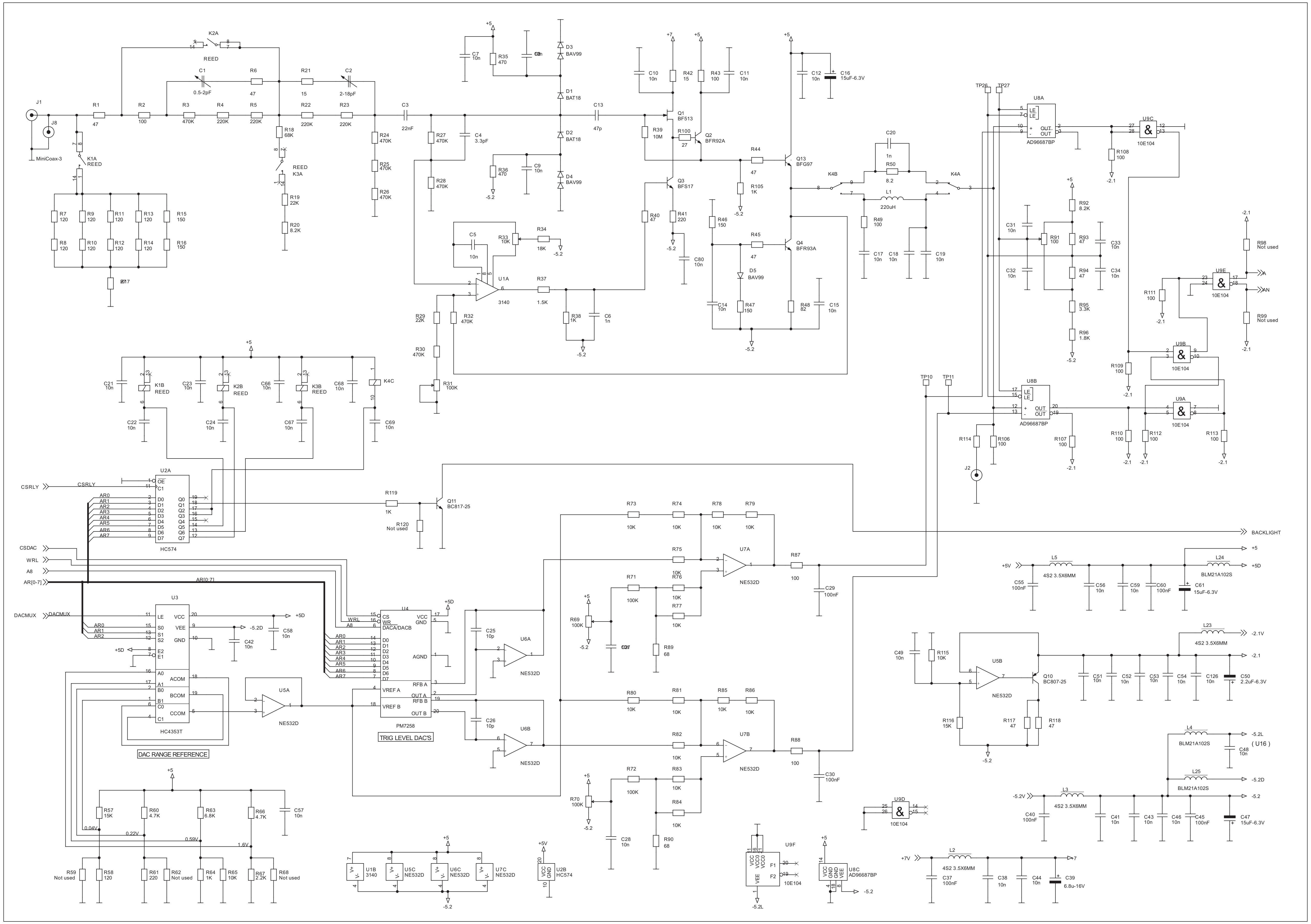
Input Amplifier & Trigger Level DACs, PCB 1, Sheet 3(5)



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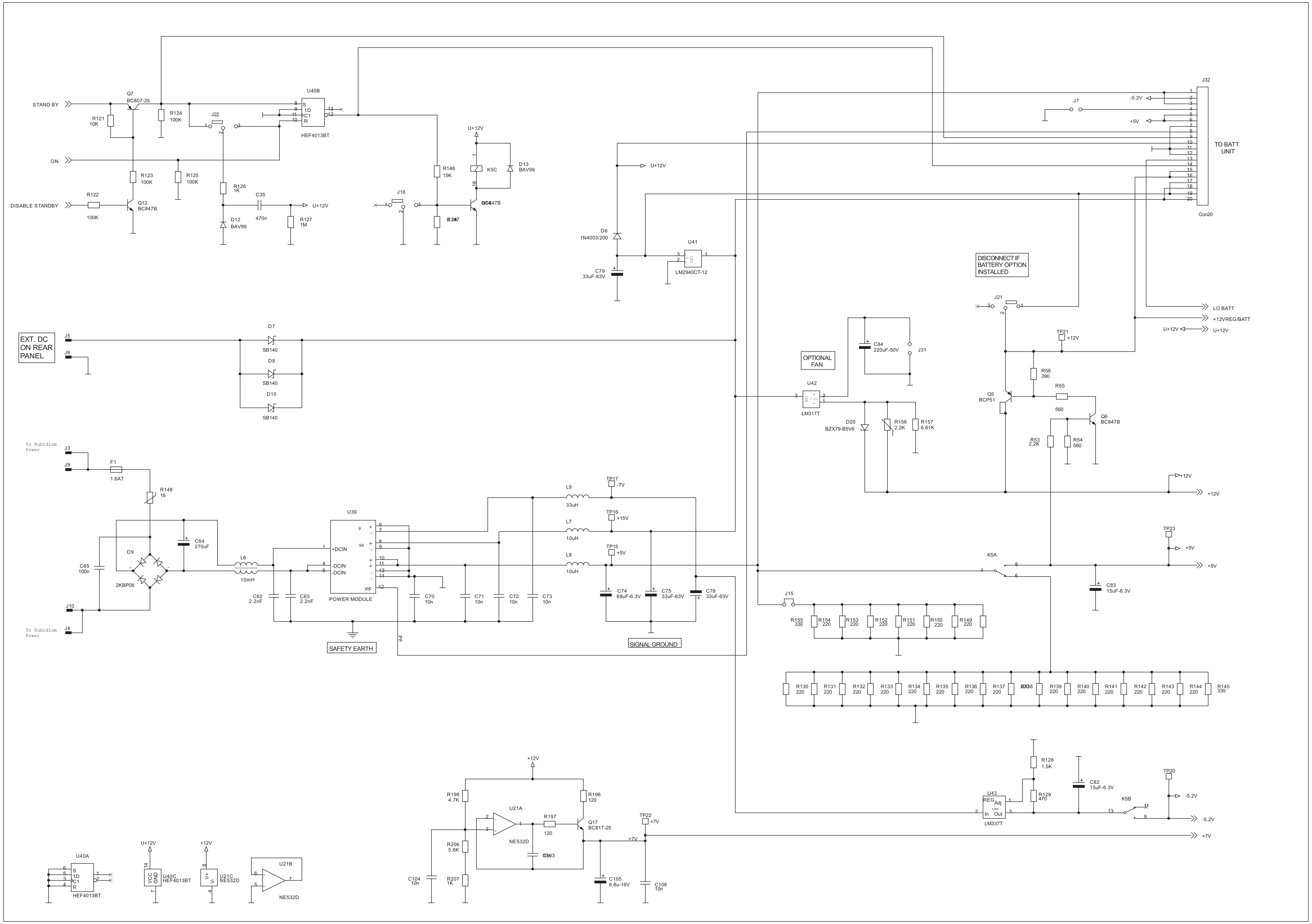
Power Supply, PCB 1, sheet 4(5)



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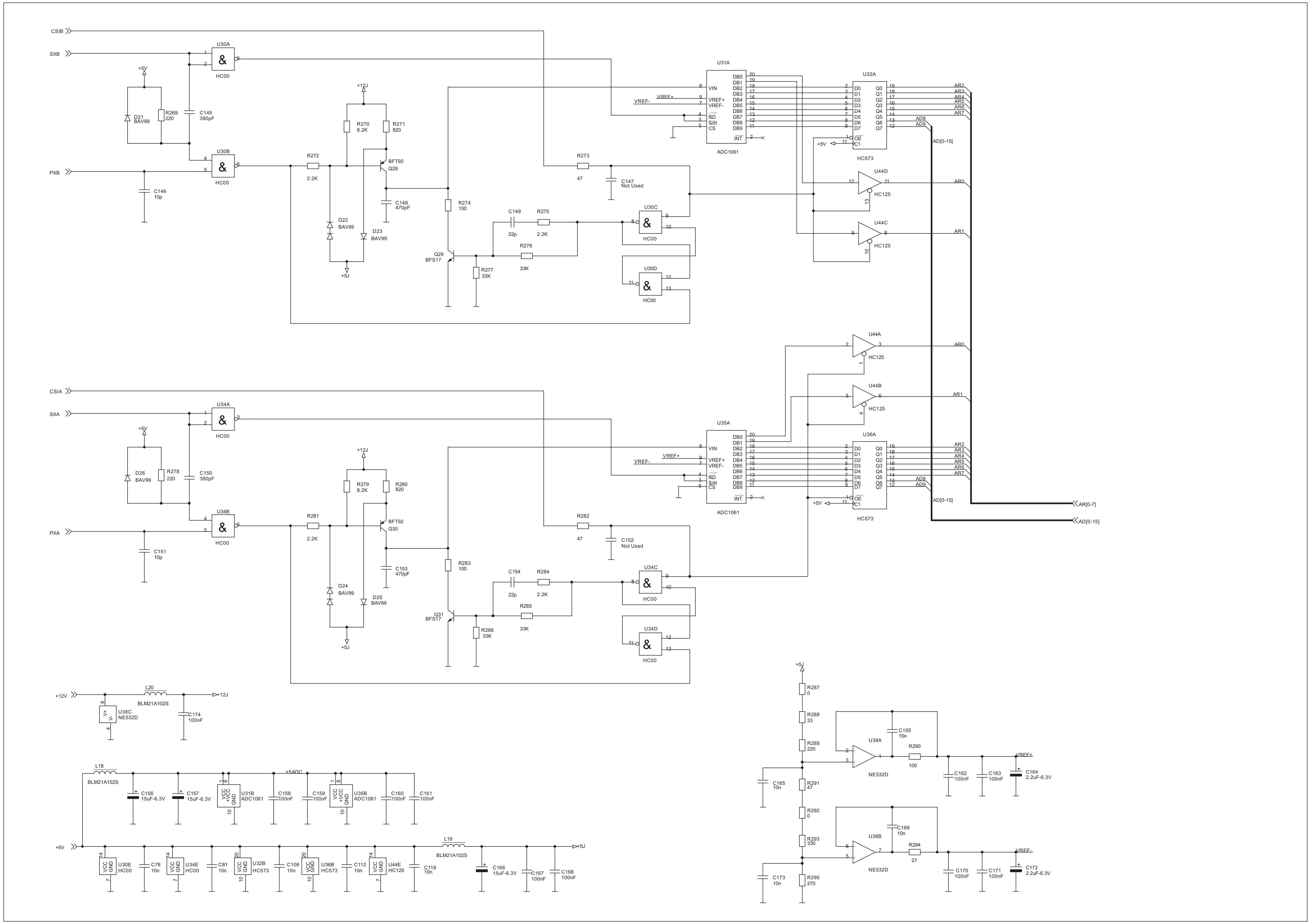
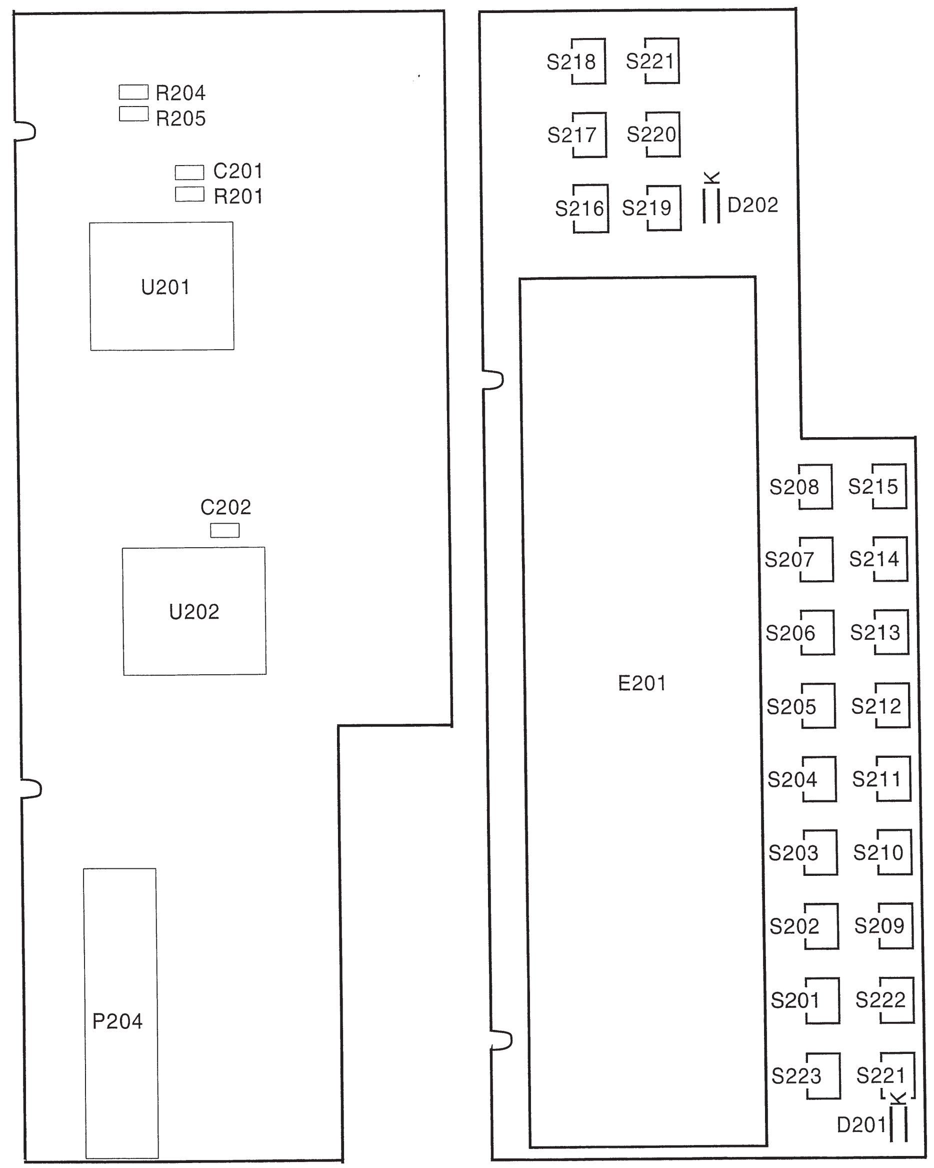
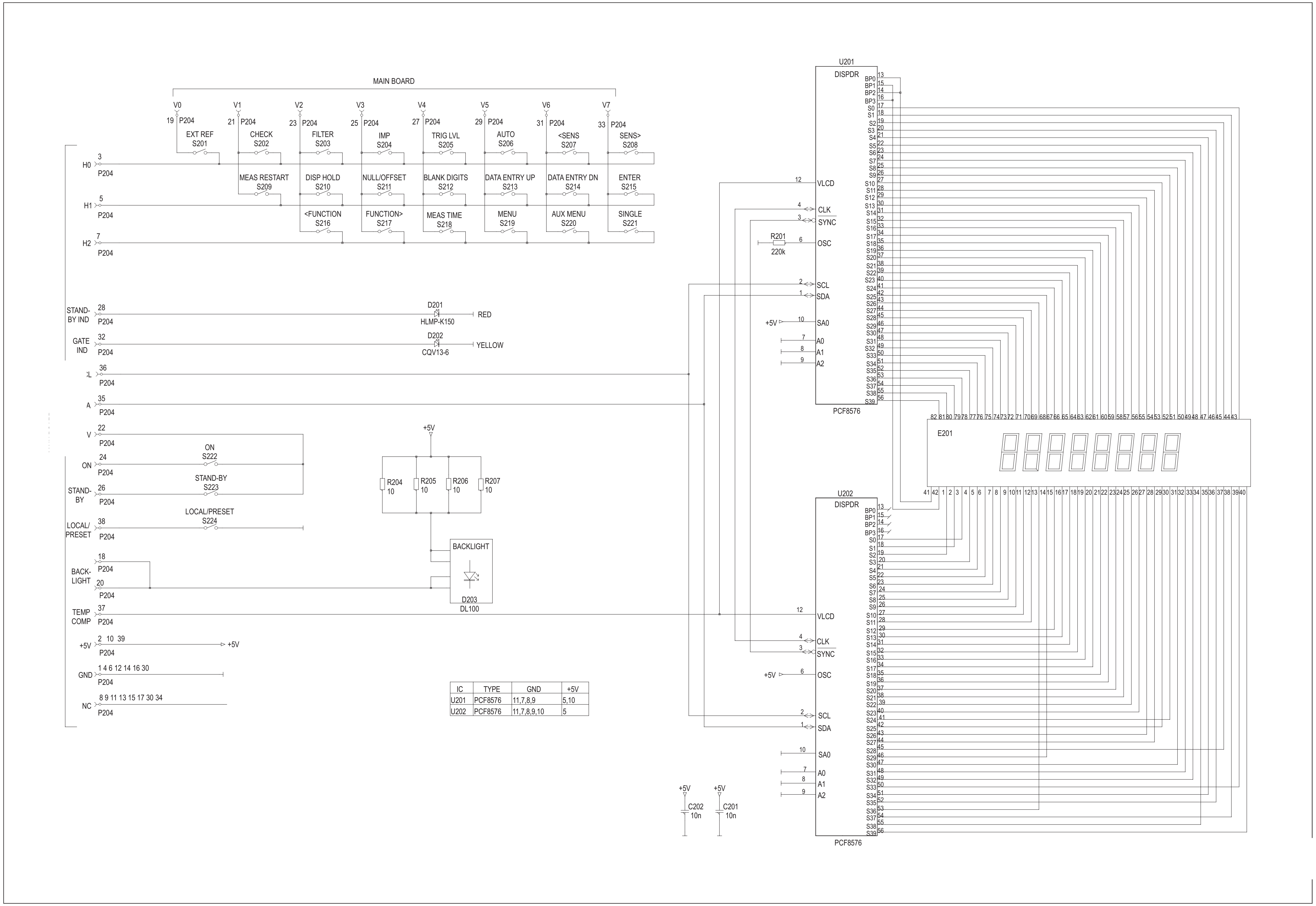
Interpolators, PCB 1, sheet 5(5)



Display & Keyboard PCB, Component layout

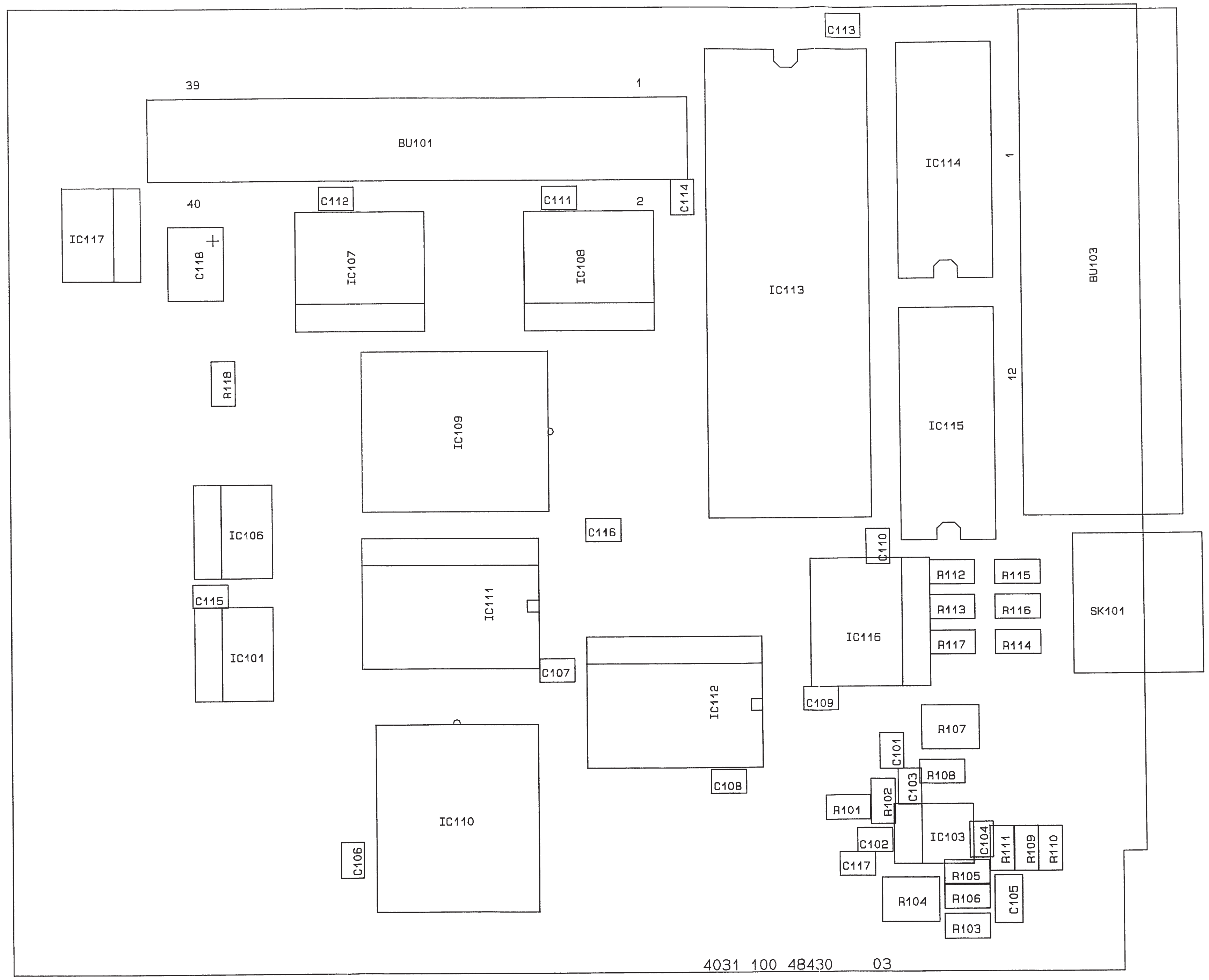
Display and keyboard board			
IC	Type	GND	+5
U201	PCF8576	7, 8, 9, 11	5, 10
U202	PCF8576	7, 8, 9, 10, 11	5





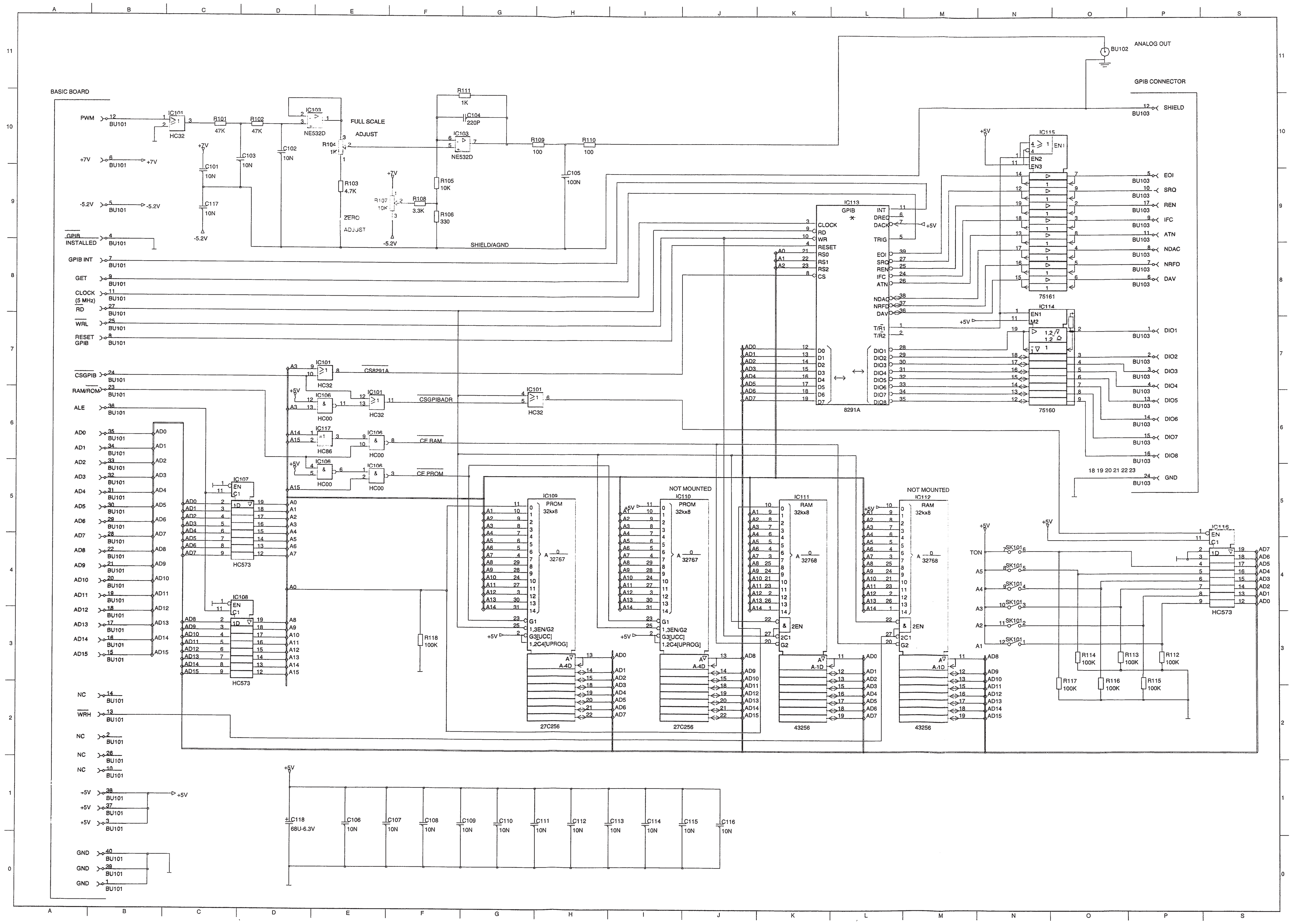
IC	TYPE	GND	+5V
U201	PCF8576	11,7,8,9	5,10
U202	PCF8576	11,7,8,9,10	5

GPIB Unit, PM9626B, *Component layout*



GPIB board

IC	Type	-5.2V	GND	+5	NC
IC101	74HC32		7	14	
IC103	NE532D	4			8=+7V
IC106	74HC00		7	14	
IC107	74HC573		10	20	
IC108	74HC573		10	20	
IC109	27C256-1		16	32	1, 12, 17, 26
IC110	27C256-1		16	32	1, 12, 17, 26
IC111	43256		14	28	
IC112	43256		14	28	
IC113	8291A		20	40	
IC114	75160		10	20	
IC115	75161		10	20	
IC116	74HC573		10	20	
IC117	74HC86		7	14	4, 5, 6, 8, 9, 10, 11, 12, 13



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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:

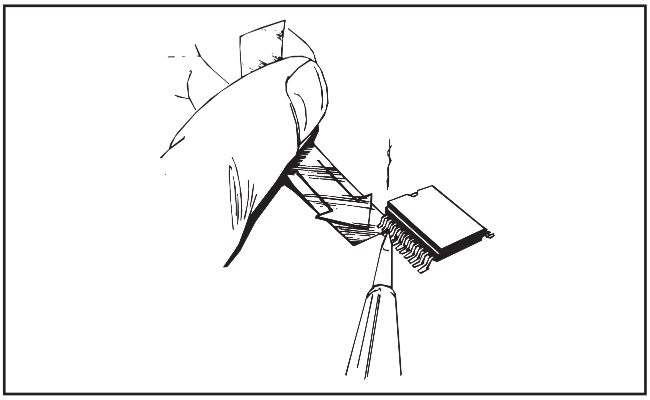

Fig. 9-1 *Heat the leads and push a thin aluminum sheet between the leads and the PC-board.*

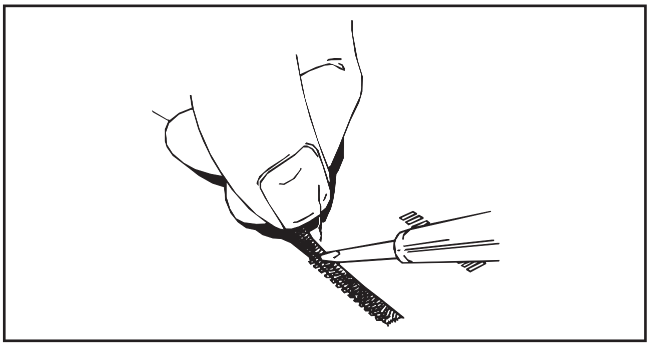

Fig. 9-2 *When removed, clean the pads with desoldering braid.*

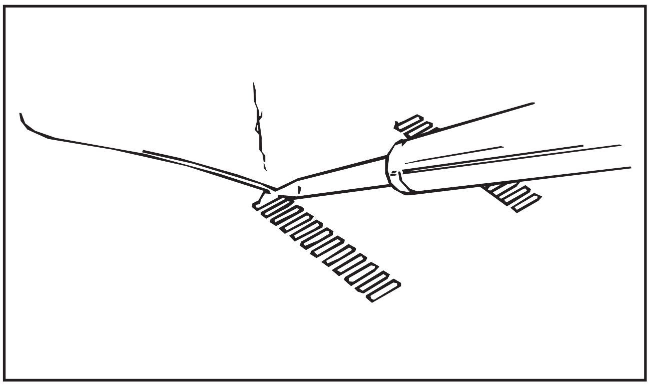

Fig. 9-3 *Place solder on the pad.*

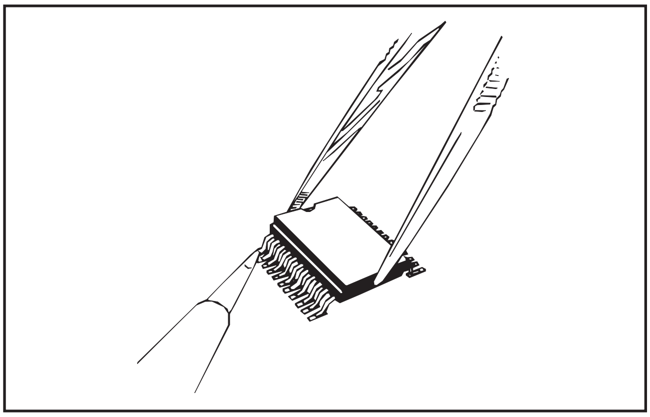

Fig 9-4 *Attach the IC to the pad with the solder.*

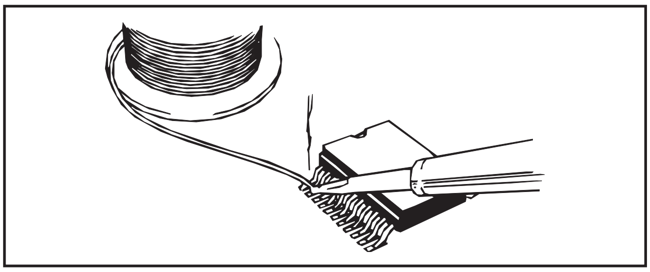

Fig. 9-5 *Solder all leads with plenty of solder; don't worry about short-circuits at this stage.*

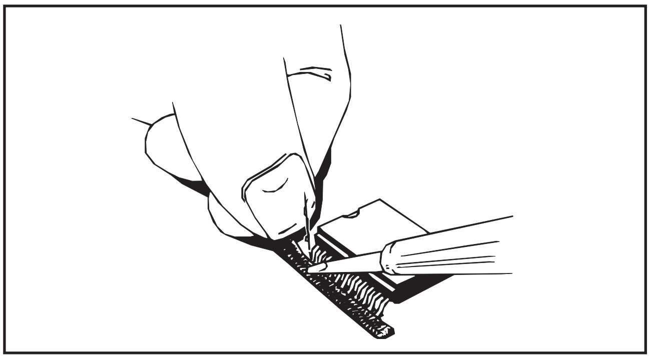

Fig. 9-6 *Remove excessive solder with desoldering braid.*

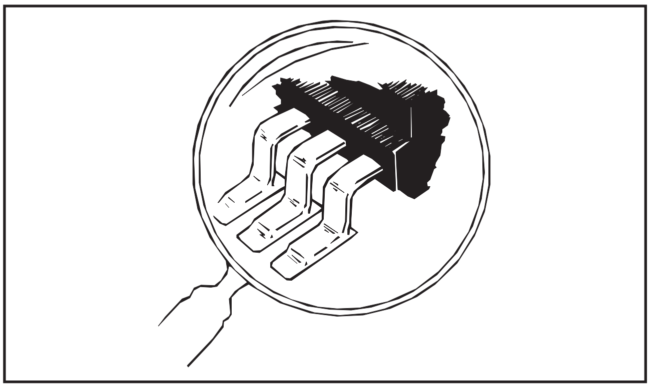

Fig. 9-7 *Use a strong magnifying glass to make sure there are no short-circuits or unsoldered leads.*

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 lectro-tatic Discharge, (ESD) sensitivity of MOS and CMOS semiconductors have been known quite a while, but nowadays bipolar semiconductors and even precision resistors are ESD sensitive. **Consider therefoe 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 the symbol to the leftl.

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 work-bench.

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 non conductive plastics etc. away from your work-bench. 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 Standards Association safety standard.

G

GaAs	A technique to make very fast IC's using Gallium Arsenide substrate.
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 Integrated circuit

O

OCXO	Oven-Controlled X-tal Oscillator

P

PCA	Printed Circuit Assembly
PCB	Printed Circuit Board
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 calibrate.
PWM	Pulse Width Modulation

T

TCXO	Temperature-Controlled X-tal Oscillator

Power Supply Switchmode Module

Circuit Descriptions

■ Primary Circuits

For primary circuits outside the power supply module, see Chapter 4, Circuit Descriptions, Power Supply.

The power supply module generates three DC voltages to the secondary circuits.

R24-R27, R31, and R32 give the start-up voltage to the control circuit U03. U03 outputs a frequency of 120 kHz on OUT (pin 10) to the switch transistor V01. When the switch transistor has started, U03 will be supplied from the transformer T01 pin 3 via the diodes D09.

Every switch pulse causes a voltage drop over the resistors R35-R37 and R55. This voltage feeds the SENSE input (pin 5) of the control circuit U03. When the voltage has reached the internal reference level in U03, the switch transistor V01 is turned off.

V05 is a blanking transistor that will compensate for high transients generated by the transformer T01.

The internal sawtooth generator RC (pin 7) in U03 is connected to the SENSE input via V03, to compensate for low load.

The regulated +5 V is sensed by U01 and adjusted by R50. The output of U03 is connected to the VF input (pin 3) of U03 via the optocoupler U02.

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

■ Secondary circuits

For secondary circuits see Chapter 4, Circuit Descriptions, Power Supply.

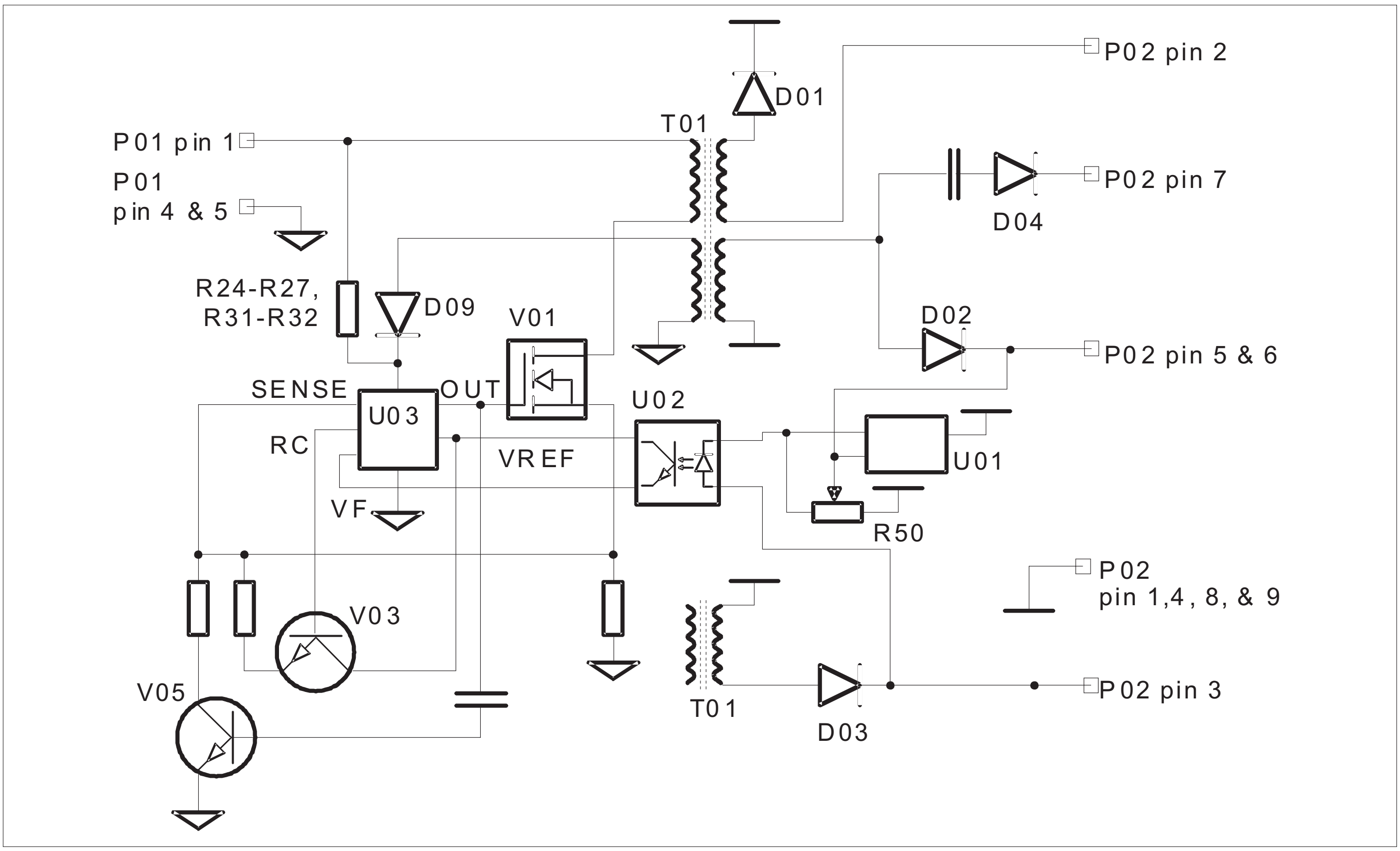

Fig. 9-8 *Power supply module primary circuits.*

Repair

Troubleshooting

■ Required Test Equipment

To be able to test the instrument properly using this manual you will need the equipment listed in Table 9-1. The list contains specifications for the critical parameters.

Type	Performance
DMM	3.5 digits
Oscilloscope	50 MHz 2-channel

Table 9-1 *Required test equipment.*

■ Operating Conditions

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

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.

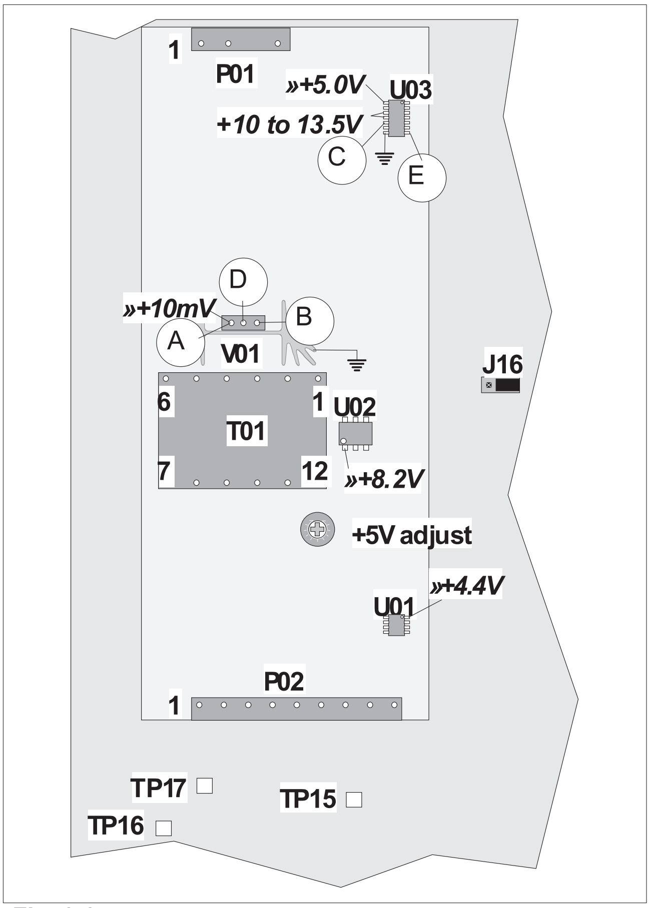

Fig. 9-9 *Test points and voltages for the power supply.*

■ Primary circuits

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

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 measurements.

– Remove the cover from the power supply.

– Disconnect the power module from the main PCA and check the resistance between pin 1 and 4 on the transformer T01, see Fig. 9-9. If the DMM shows a short circuit, the fault is proabably a broken transistor V01. Put the power module back.

– 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 J9 and J10 is in the range of 90 to 260 V_{AC}.

– Check that the DC voltage between pin 1 and 4 on T01 is about √2 times the input AC voltage. If not, use traditional faultfinding techniques to locate the fault.

– Disconnect the secondary load by moving the jumper J16 to its alternative position.

– Check the “STAND BY” voltages according to Table 9-2.

Test points	Ground	Voltage
U03 pin 11 & 12	U03 pin 8	+10 to +13.5 V
U03 pin 14	U03 pin 8	+5.0 V
V01 source	U03 pin 8	+10 mV
U02 pin 1	Amplifier Screen	+8.2 V
U01 pin 1	Amplifier Screen	+4.4 V
TP15	Amplifier Screen	+5.1 V
TP16	Amplifier Screen	+14.8 V to +21 V
TP17	Amplifier Screen	–12.5 V to –7.5 V
TP21	Amplifier Screen	+12 V ±0.5 V

Table 9-2 *Stand-by voltages.*

– Restore the jumper J16 to its normal position.

– Check the waveforms in Fig. 9-10 at the corresponding testpoints in Fig. 9-9 to verify the primary circuits. Use the heat-sink of V01 as ground.

NOTE: U01 and U03 are located at the bottom side of the PCA.

■ Secondary circuits

For secondary circuits see Chapter 5, Repair, Power Supply.

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.

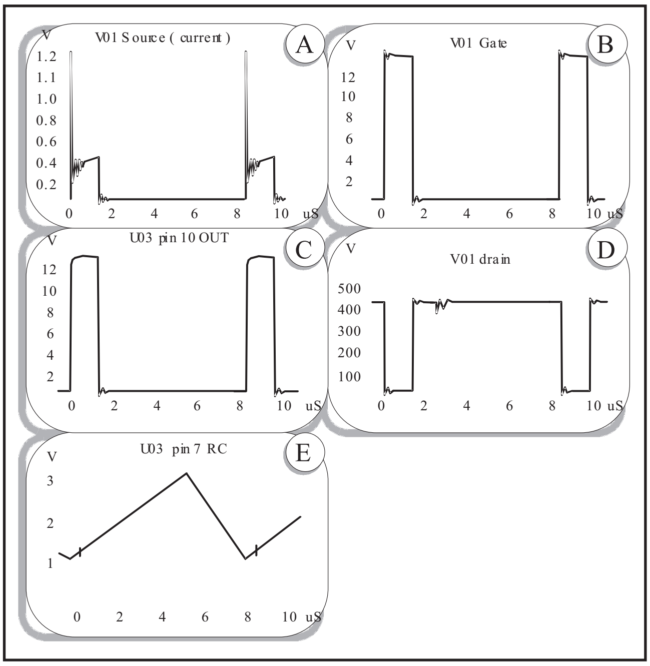

Fig. 9-10 *Typical curves of the power supply.*

Safety Components

Components in the primary circuits are important to the safety of the instrument and may be replaced only 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.

Calibration Adjustments

Required Test Equipment

Type	Performance
DMM	3.5 digits

Table 9-3 *Required Test Equipment.*

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.

■ Setup

– Connect the counter to the line power.

– Switch on the counter.

– Press PRESET, then press ENTER.

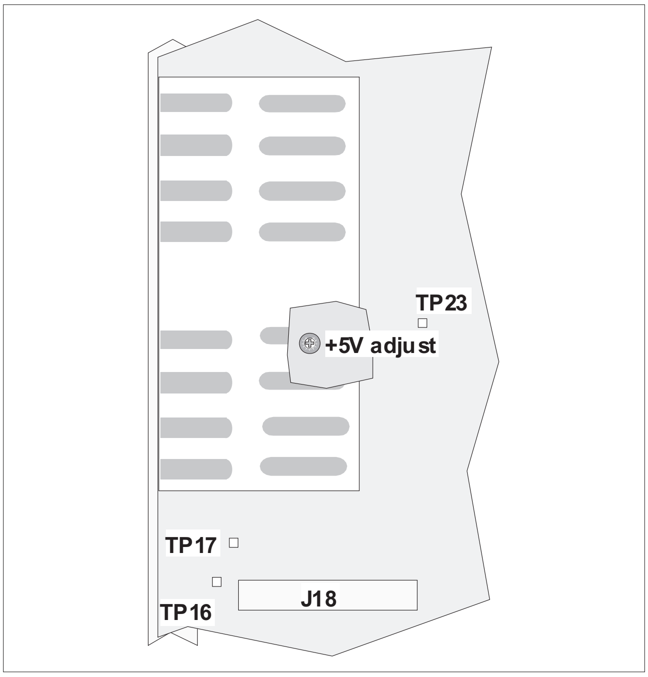

Fig. 9-11 *Test points and trimmer for the power supply.*

■ Adjustment

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

– Connect the DMM between TP23 and ground, see Fig. 9-11.

– Adjust the +5 V trimmer potentiometer R50 in the power supply through the nearest vent in the protective cover, until the DMM reads +5.00 ± 0.01 V.

– Check that the unregulated voltage from the power supply at test point TP16=+15 is about +18 V.

– Check that the unregulated voltage from the power supply at test points TP17=–7 is about –8 V.

Replacement Parts

Pos	Description	Part Number	☆
	Heat Sink 16°K/W TO220	5322 255 41313	P
	Heat Sink 13.5°K/W TO220	5322 255 41314	P
C01	Capacitor 1 nF 5% 63V	4822 122 31746	
C02	Capacitor 1 nF 5% 63V	4822 122 31746	
C03	Capacitor 220 pF 20% 200V	5322 126 13129	
C04	Capacitor 33 nF 10% 50V	4822 122 31981	
C05	Capacitor 33 nF 10% 50V	4822 122 31981	
C06	Capacitor 33 nF 10% 50V	4822 122 31981	
C07	Capacitor 100 nF 10% 63V	4822 122 33496	
C08	Capacitor 100 nF 10% 63V	4822 122 33496	
C09	Capacitor 47 nF 10% 250V	4822 121 41676	
C10	Capacitor 330 nF 20% 250V	5322 121 44222	
C12	Capacitor 100 μF 20% 35V	5322 124 40852	
C13	Capacitor 220 pF 20% 200V	5322 126 13129	
C14	Capacitor 100 pF 5% 63V	4822 122 31765	
C15	Capacitor 22 pF 5% 63V	4822 122 32482	
C16	Capacitor 4.7nF 10% 63V	4822 122 31784	
C17	Capacitor 4.7nF 10% 63V	4822 122 31784	
C18	Capacitor 100 nF 10% 63V	4822 122 33496	
C19	Capacitor 100 nF 10% 63V	4822 122 33496	
C20	Capacitor 100 nF 10% 63V	4822 122 33496	
C21	Capacitor 470 μF 20% 35V 2M	5322 126 13131	
C22	Capacitor 470 μF 20% 35V 2M	5322 126 13131	
C23	Capacitor 10000 μF 20% 6.3V	5322 124 80821	
C24	Capacitor 1 nF 5% 63V	4822 122 31746	
C25	Capacitor 100 nF 10% 63V	4822 122 33496	
C26	Capacitor 100 nF 10% 63V	4822 122 33496	
C27	Capacitor 100 nF 10% 63V	4822 122 33496	
C28	Capacitor 220 pF 20% 200V	5322 126 13129	
D01	Diode 7A BYW29/200	5322 130 32328	
D02	Diode 7.5A MBR760 60V	5322 130 83602	
D03	Diode 7A BYW29/200	5322 130 32328	
D04	Diode 0.2A BAV23 200V	5322 130 33764	
D06	Diode 0.35 W BZX84-C8V2	5322 130 80255	
D07	Diode BYV26E DOD57	4822 130 60815	
D08	Diode 0.35 W BZX84-C18	5322 130 80212	
D09	Diode 0.2A BAV23 200V	5322 130 33764	
D11	Diode 0.35 W BZX84-C18	5322 130 80212	
D12	Diode 0.35 W BZX84-C18	5322 130 80212	
D13	Diode 0.35 W BZX84-C8V2	5322 130 80255	
D14	Diode 0.2A BAV23 200V	5322 130 33764	
R01	Resistor 82 kΩ 1% .125W	4822 051 10829	
R02	Resistor 82 kΩ 1% .125W	4822 051 10829	
R03	Resistor 270 kΩ 1% .125W	4822 051 10271	
R04	Resistor 10.0 kΩ 1% 0.125W	4822 051 51003	
R06	Resistor 2.20 kΩ 1% .125W	5322 116 80434	
R07	Resistor 1.00 kΩ 1% 0.125W	4822 051 51002	
R08	Resistor 1.80 kΩ 1% .125W	4822 051 10182	
R09	Resistor 3.90 kΩ 1% .125W	5322 116 80443	
R10	Resistor 47 kΩ 1% .125W	5322 116 80446	
R11	Resistor 220 kΩ 1% .125W	5322 116 80436	
R12	Resistor 10.0 kΩ 1% 0.125W	4822 051 51003	
R13	Resistor 10.0 kΩ 1% 0.125W	4822 051 51003	
R14	Resistor 10.0 Ω 1% 0.125W	4822 051 51003	
R15	Resistor 10.0 kΩ 1% 0.125W	4822 051 51003	
R16	Resistor 10.0 kΩ 1% 0.125W	4822 051 51003	

Pos	Description	Part Number	☆
R17	Resistor 10.0 kΩ 1% 0.125W	4822 051 51003	
R18	Resistor 10.0 kΩ 1% 0.125W	4822 051 51003	
R19	Resistor 10.0 kΩ 1% 0.125W	4822 051 51003	
R20	Resistor 10.0 kΩ 1% 0.125Ω	4822 051 51003	
R24	Resistor 100 kΩ 1% 0.125W	4822 051 51004	
R25	Resistor 100 kΩ 1% 0.125W	4822 051 51004	
R26	Resistor 100 kΩ 1% 0.125W	4822 051 51004	
R27	Resistor 100 kΩ 1% 0.125W	4822 051 51004	
R28	Resistor 10.0 kΩ 1% 0.125W	4822 051 51003	
R29	Resistor 4.7 Ω 10% 0.25W	4833 051 10478	
R30	Resistor 10.0 kΩ 1% 0.125W	4822 051 51003	
R31	Resistor 100 kΩ 1% 0.125W	4822 051 51004	
R32	Resistor 100 kΩ 1% 0.125W	4822 051 51004	
R33	Resistor 10.0 Ω 1% 0.125W	4822 051 10109	
R34	Resistor 1.00 kΩ 1% 0.125W	4822 051 51002	
R35	Resistor 2.7 Ω 5% 0.25W	4822 051 10278	
R36	Resistor 2.7 Ω 5% 0.25W	4822 051 10278	
R37	Resistor 2.7 Ω 5% 0.25W	4822 051 10278	
R38	Resistor 1.00 kΩ 1% 0.125W	4822 051 51002	
R39	Resistor 10.0 Ω 1% 0.125W	4822 051 10109	
R40	Resistor 100 Ω 1% 0.125W	5322 116 80426	
R41	Resistor 100 Ω 1% 0.125W	5322 116 80426	
R42	Resistor 1.00 kΩ 1% 0.125W	4822 051 51002	
R43	Resistor 100 Ω 1% 0.125Ω	5322 116 80426	
R44	Resistor 100 Ω 1% 0.125Ω	5322 116 80426	
R45	Resistor 1.00 kΩ 1% 0.125Ω	4822 051 51002	
R46	Varistor 95V 95VRMS4.1J	5322 116 21222	P
R47	Resistor 4.70 kΩ 1% .125W	5322 116 80445	
R48	Resistor 10.0 kΩ 1% 0.125W	4822 051 51003	
R49	Resistor 22.0 kΩ 1% .125W	5322 116 80435	
R50	Potentiometer 1 kΩ 20%	4822 101 10792	
R51	Resistor 3.30 kΩ 1% .125W	4822 051 53302	
R52	Resistor 8.20 kΩ 1% .125W	4822 051 10822	
R53	Resistor 470 kΩ 1% .125W	5322 116 80447	
R54	Resistor 470 kΩ 1% .125W	5322 116 80447	
R55	Resistor 2.7 Ω 5% 0.25W	4822 051 10278	
R56	Resistor 100 Ω 1% 0.125W	5322 116 80426	
R57	Resistor 47 Ω 1% .125W	5322 116 80448	
R58	Resistor 270 Ω 1% .125W	4822 051 10271	
T01	Transformer	5322 148 20035	P
U01	IC-ref 2.5V TL431I-D SO8	5322 209 62422	
U02	Optocoupler CNX82A	4822 130 10025	
V02	Transistor 0.50 A BC807-25	5322 130 60845	
V03	Transistor 0.50 A BC817-25	4822 130 42804	
V04	Transistor 0.50 A BC817-25	4822 130 42804	
V05	Transistor 0.50 A BC817-25	4822 130 42804	
V06	Transistor 0.50 A BC817-25	4822 130 42804	
V07	Transistor 0.50 A BC817-25	4822 130 42804	
V08	Transistor 0.50 A BC807-25	5322 130 60845	

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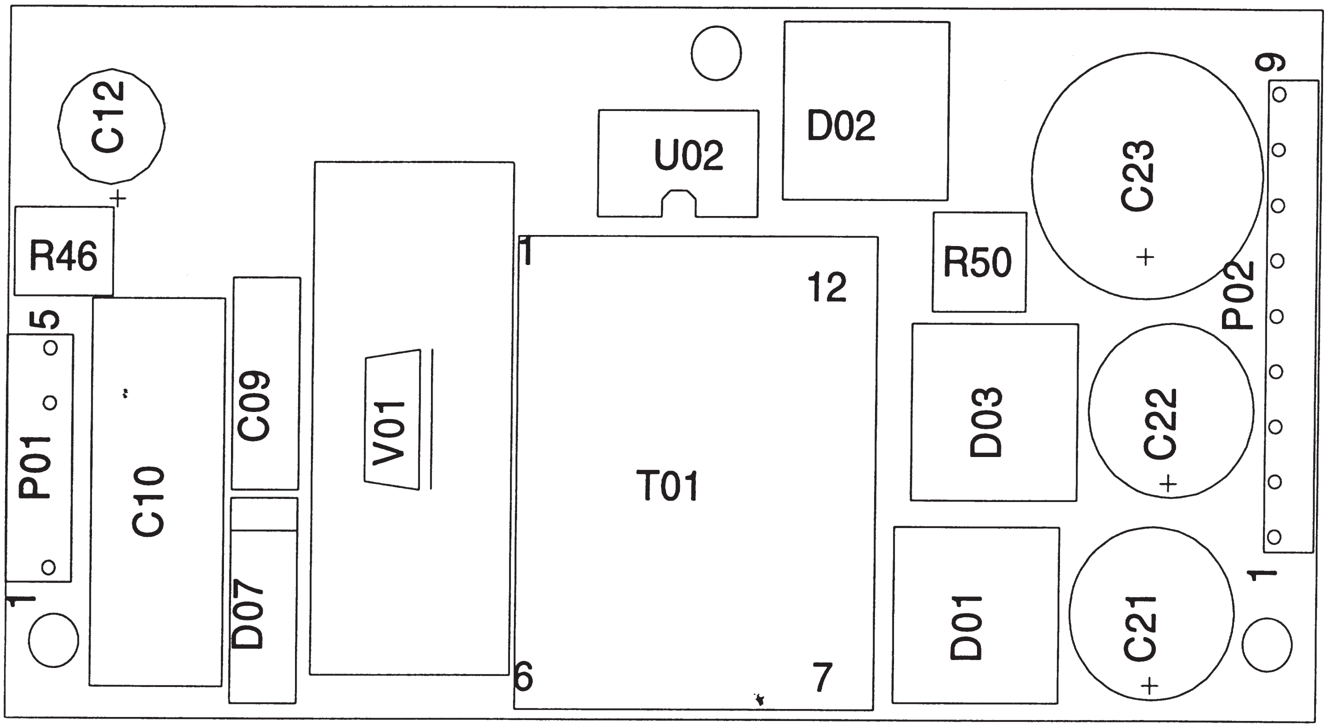
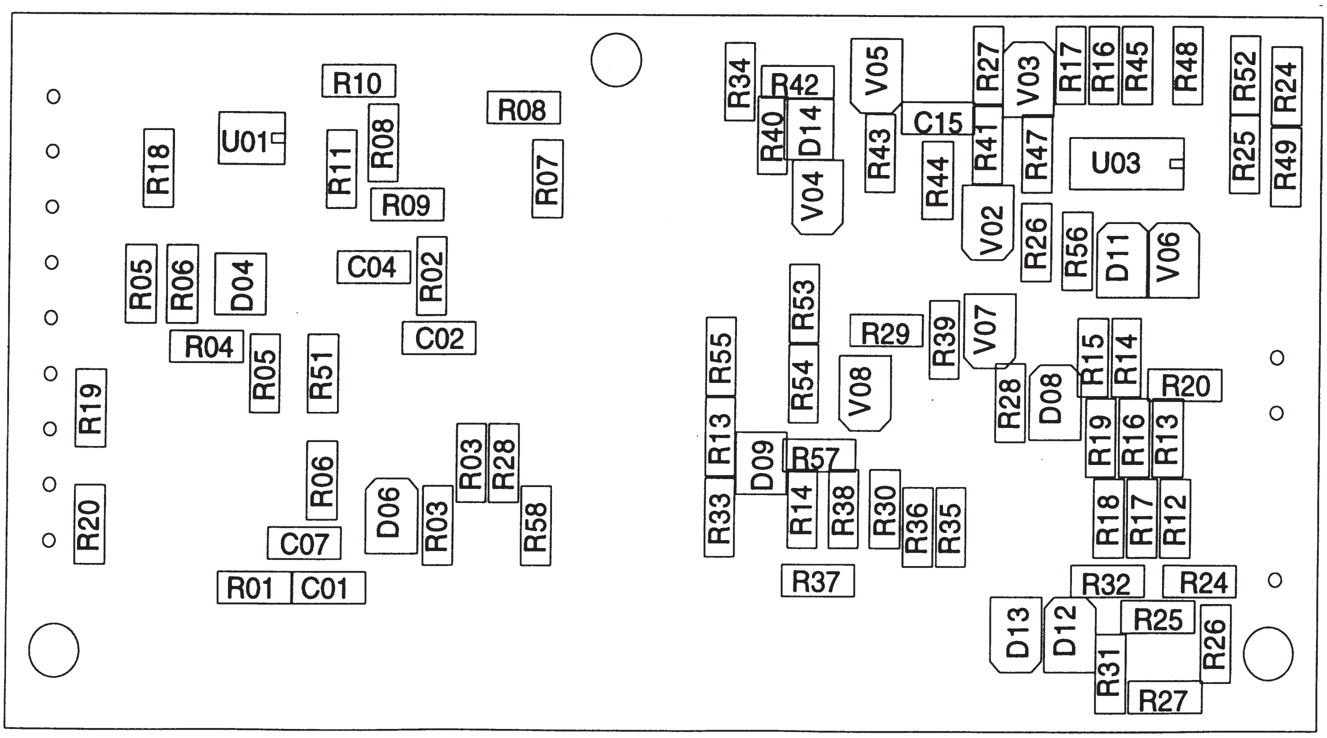
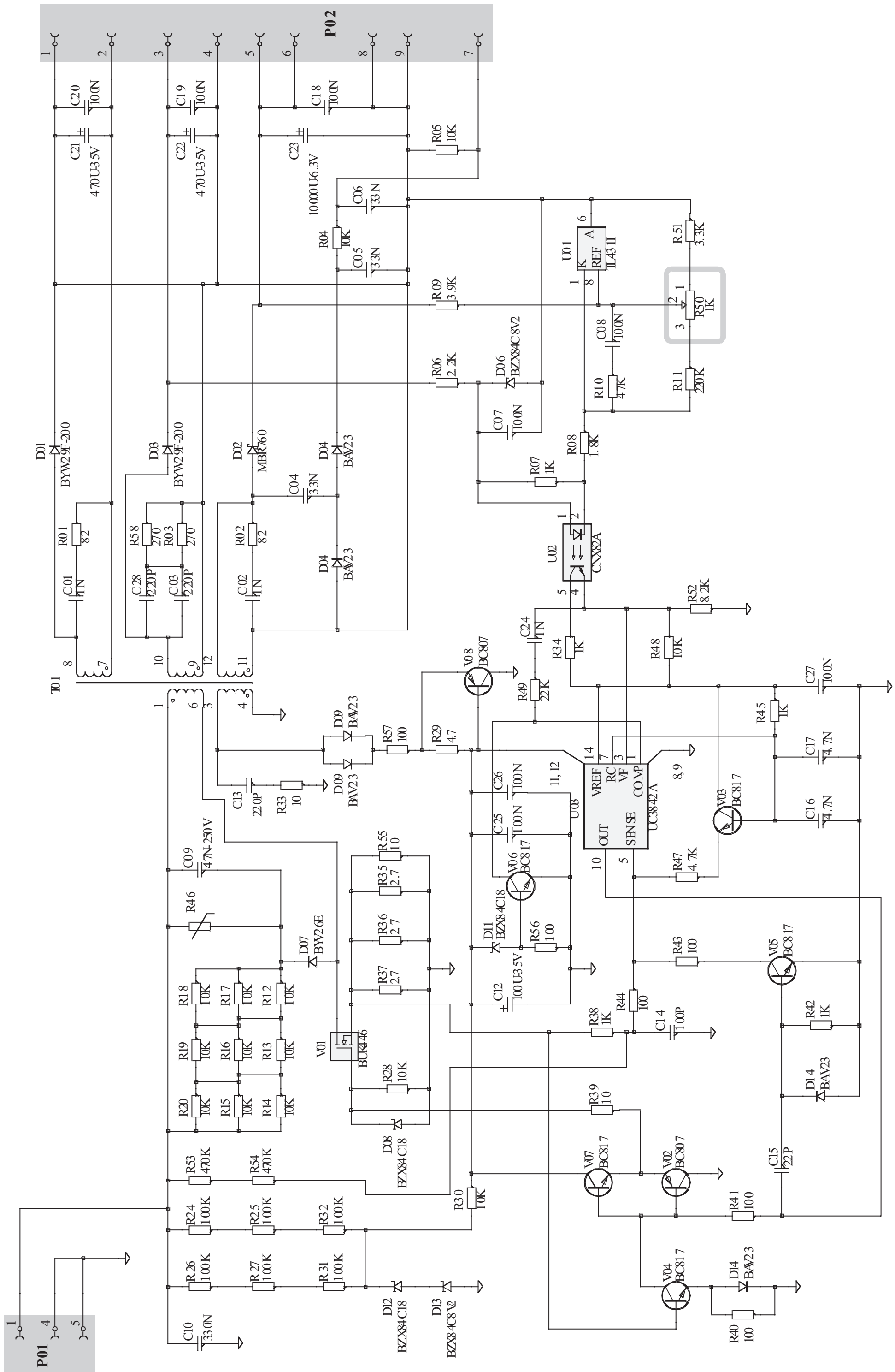
Power Supply, Component layout

TOP SIDE



BOTTOM SIDE




P02
P01
T01
U01
TL431
U02
CNX82A
U03
UC3842A
VREF
RC
VF
COMP
OUT
SENSE
D01
BYW29F-200
D03
BYW29F-200
D02
MBR760
C20
100N
C21
470U35V
C19
100N
C22
470U35V
C18
100N
C23
10000U6.3V
R05
10K
R09
3.9K
R06
2.2K
D16
BZX84C8V2
R51
3.3K
R50
1K
R11
220K
R10
4.7K
C08
100N
R08
1.8K
R07
1K
C07
100N
R52
8.2K
R48
10K
R34
1K
C24
1N
V08
BC807
R49
22K
R45
1K
C27
100N
C17
4.7N
C16
4.7N
V03
BC817
R47
4.7K
R43
100
V05
BC817
R42
1K
D14
BAV23
C15
22P
R41
100
V07
BC817
V02
BC807
V04
BC817
R40
100
R39
10
R38
1K
R44
100
C14
100P
C12
100U35V
R56
100
D11
BZX84C18
V06
BC817
C25
100N
C26
100N
R29
4.7
R57
100
D09
BAV23
C13
220P
R33
10
C09
4.7N-250V
R46
D07
BYW26E
V01
BUK446
R28
10K
D08
BZX84C18
R30
10K
R53
470K
R54
470K
R24
100K
R25
100K
R32
100K
R26
100K
R27
100K
R31
100K
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D13
BZX84C8V2
C10
330N
R01
82
R58
270
R03
270
R02
82
C01
1N
C28
220P
C03
220P
C02
1N
C04
3.3N
D04
BAV23
R04
10K
C05
3.3N
C06
3.3N
R55
10
R35
2.7
R36
2.7
R37
2.7

PM6685R

Introduction

A Rubidium timebase is now available for the PM6685 Frequency counter. This oscillator cannot be retrofitted in the standard version of the PM6685. Due to the size of the timebase and its power requirements, a larger cabinet must be used.

A fan is needed to keep the temperature to an acceptable level.

This version is called PM6685R, where “R” stands for Rubidium.

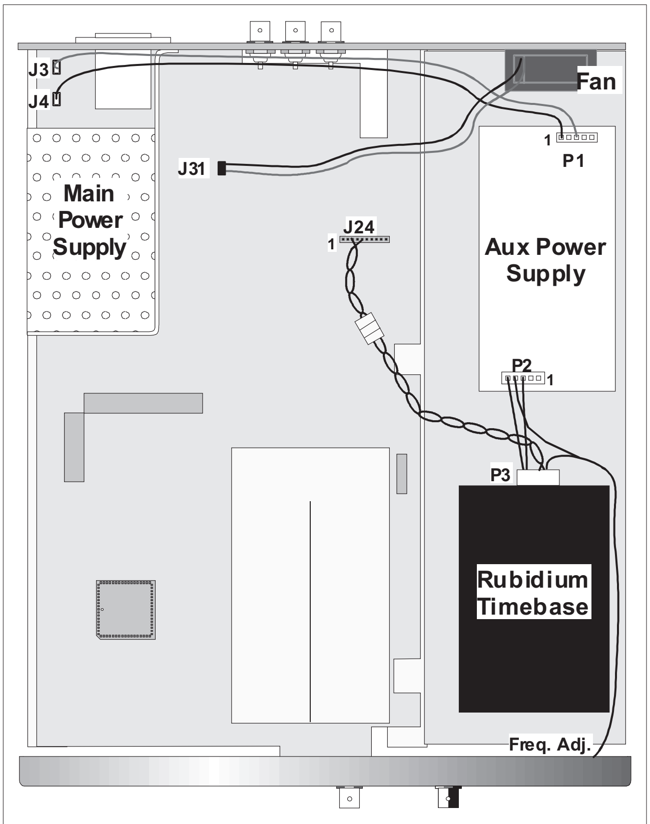

Fig. 9-12 *Location of the Rubidium Timebase and its power supply.*

Performance Check

Required Test Equipment

Type	Performance	Model
10 MHz reference	$\leq 1x10^{-10}$	Calibrated Rubidium oscillator or Cesium atomic standard

Table 9-4 *Required test equipment*

NOTE: To fully test the accuracy of the PM6685R, 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 PM6685R is equipped with an LED labelled “UNLOCKED”. 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 UNLOCK LED is lit.

– Check that the UNLOCK LED is switched off within ≤ 6 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.

Functional Description

The oscillator is supplied with 24 V from the extra power supply.

The oscillator generates a stable 10 MHz output frequency from a 20 MHz Voltage Controlled Crystal Oscillator (VCXO), whose frequency is locked to the atomic-standard “resonance frequency” of the rubidium atom, see Fig. 9-14.

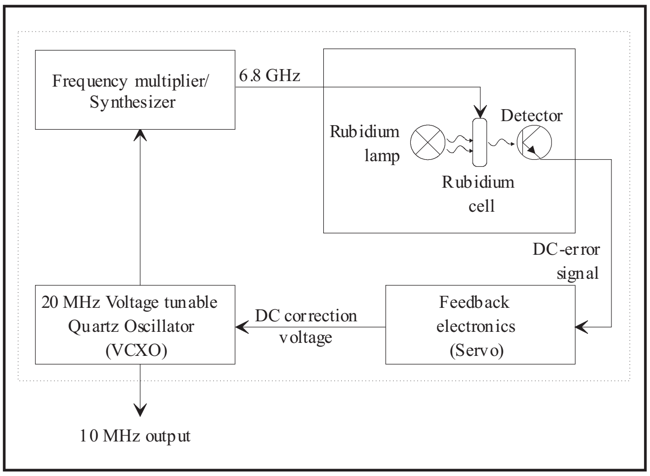

Fig. 9-14 *Block diagram showing the principle of a Rubidium Atomic Standard.*

A microwave signal that is derived from the VCXO tunable oscillator is applied to rubidium vapor contained within a heated glass cell. Light from a rubidium lamp is passed through the cell and illuminates a photo detector causing current to flow in the detector. As the applied microwave signal approaches the frequency that corresponds to the ultra stable rubidium atomic resonance frequency, the rubidium light entering the glass cell is absorbed by the rubidium vapor to an increased extent causing a decrease in the photo detector current. This “darkening” effect is used to generate an error signal which permits continuous regulation of the quartz crystal oscillator output frequency, thereby locking it to the frequency of the atomic standard .

Calibration Adjustments

NOTE: Before Calibration Adjustment, the Rubidium time base must have been in operation for more than 24 hours.

Required Test Equipment

Type	Performance	Model
10 MHz reference	$\leq 1x10^{-10}$	Calibrated Rubidium oscillator or Cesium atomic standard

Table 9-5 *Required test equipment.*

Setup

– Connect the counter to the line power.

– Press PRESET, then ENTER.

– Press AUX.

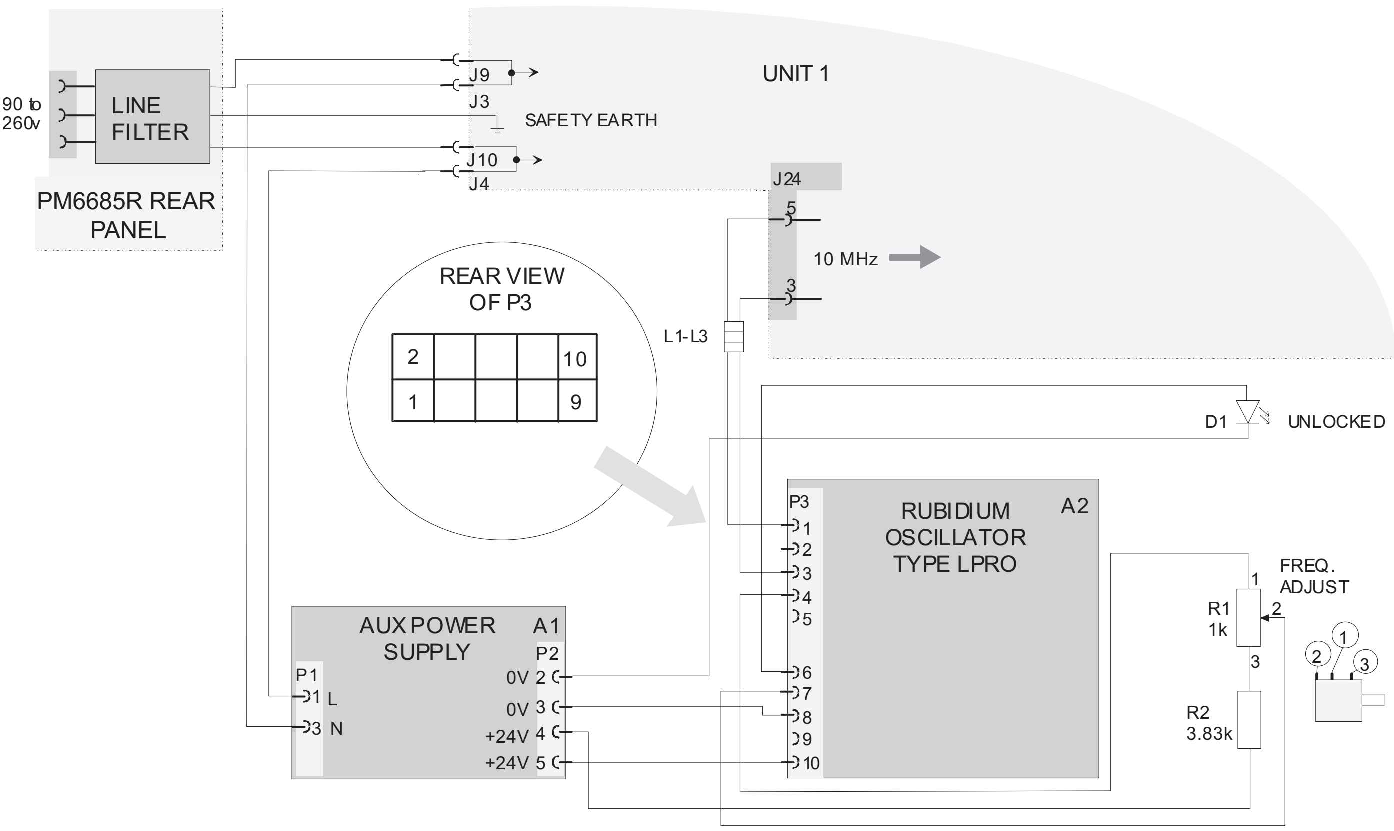

Fig. 9-13 *Wiring diagram showing the interconnections between the Rubidium timebase, its power supply, and the main PCA.*

– Select NULL by pressing ▲ or ▼.

– Press ENTER twice.

– Set the measuring time to 10 s.

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

Adjustment procedure

– Remove the seal from the front panel.

– Adjust the potentiometer beyond the seal until the display reads 0.5^{-3} Hz or less.

– Check that the value is stable over time, (more than 30 minutes).

– Cover the “CALIBRATION ADJUSTMENT” hole on the front panel with a relevant seal if necessary.

Replacement Parts

Pos	Description	Part Number	☆
	Cover, (incl. front part).	5322 447 92194	P
	Fan	2822 031 01327	R
	Text plate kit	4031 100 62440	R
	Rear plate	4031 100 53930	P
A1	Power supply	5322 214 91268	P
D1	LED, HLMP-1300, red	5322 130 81921	
L1	Toroid	5322 526 10545	
L2	Toroid	5322 526 10545	
L3	Toroid	5322 526 10545	
P1-P3	Cable kit	4031 100 61530	P
R1	Potentiometer, 1 kΩ	5322 101 11298	
R2	Resistor 3.83 kΩ, 1% 0.5 W MRS25	4822 050 23832	

NOTE: The rubidium time base (unit A2) must be sent to a Fluke service center for repair. Follow the exchange procedure.