Service Guide

Publication Number 33120-90017 (*order as 33120-90104 manual set*)
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For Safety information, Warranties, and Regulatory information, see the last page in this manual.

Agilent 33120A
15 MHz Function / Arbitrary Waveform Generator

Note: *Unless otherwise indicated, this manual applies to all Serial Numbers.*

The Agilent Technologies 33120A is a high-performance 15 MHz synthesized function generator with built-in arbitrary waveform capability. Its combination of bench-top and system features makes this function generator a versatile solution for your testing requirements now and in the future.

Convenient bench-top features

- 10 standard waveforms
- Built-in 12-bit 40 MSa/s arbitrary waveform capability
- Easy-to-use knob input
- Highly visible vacuum-fluorescent display
- Instrument state storage
- Portable, ruggedized case with non-skid feet

Flexible system features

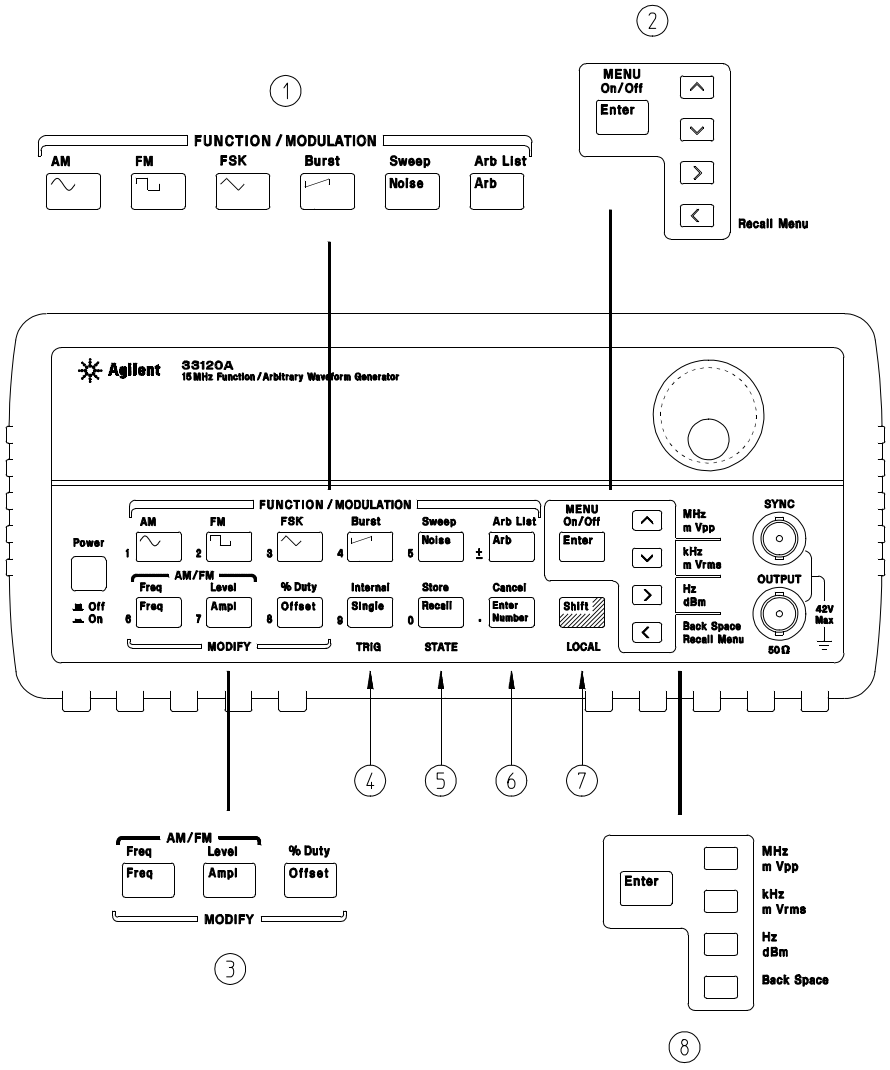
- Four downloadable 16,000-point arbitrary waveform memories
- GPIB (IEEE-488) interface and RS-232 interface are standard
- SCPI (Standard Commands for Programmable Instruments) compatibility
- Agilent *IntuiLink Arb Waveform Generation Software* for Microsoft® Windows®

Warning

The procedures in this manual are intended for use by qualified, service-trained personnel only.

Agilent 33120A
15 MHz Function / Arbitrary Waveform Generator

The Front Panel at a Glance

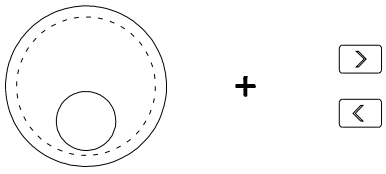


1 Function / Modulation keys
2 Menu operation keys
3 Waveform modify keys
4 Single / Internal Trigger key (*Burst and Sweep only)*
5 Recall / Store instrument state key
6 Enter Number key
7 Shift / Local key
8 Enter Number “units” keys

Front-Panel Number Entry

You can enter numbers from the front-panel using one of three methods.

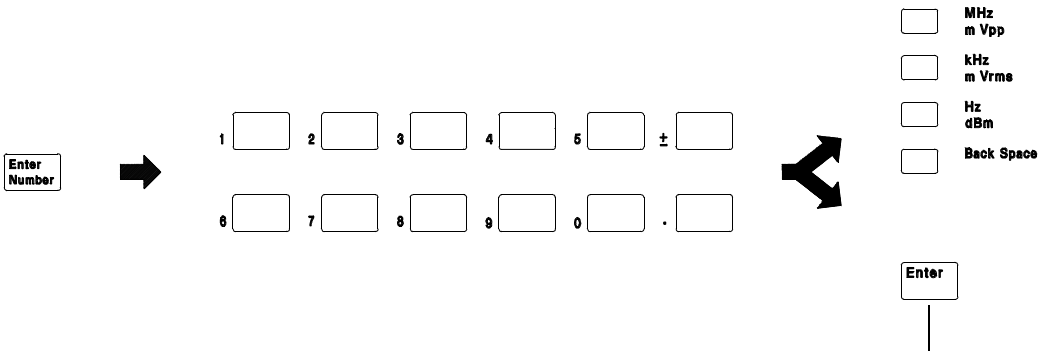
Use the knob and the arrow keys to modify the displayed number.



Use the arrow keys to edit individual digits.

- **Increments** the flashing digit.
- **Decrements** the flashing digit.
- Moves the flashing digit **to the right**.
- Moves the flashing digit **to the left**.

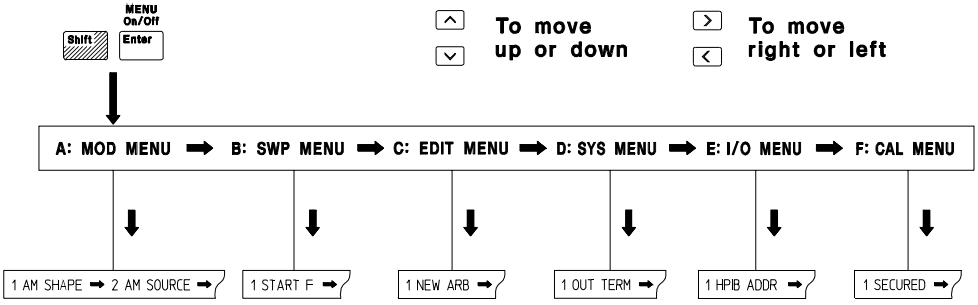
Use the "Enter Number" mode to enter a number with the appropriate units.



Use "Enter" for those operations that do not require units to be specified (AM Level, Offset, % Duty, and Store/Recall State).

The menu is organized in a top-down tree structure with three levels.

To turn on menu press:



To enter command press:

Enter

A: MODulation MENU

1: AM SHAPE ⇨ 2: AM SOURCE ⇨ 3: FM SHAPE ⇨ 4: BURST CNT ⇨ 5: BURST RATE ⇨

⇨ 6: BURST PHAS ⇨ 7: BURST SRC ⇨ 8: FSK FREQ ⇨ 9: FSK RATE ⇨ 10: FSK SRC

B: SWP (Sweep) MENU

1: START F ⇨ 2: STOP F ⇨ 3: SWP TIME ⇨ 4: SWP MODE

C: EDIT MENU*

1: NEW ARB ⇨ [2: POINTS] ⇨ [3: LINE EDIT] ⇨ [4: POINT EDIT] ⇨ [5: INVERT] ⇨ [6: SAVE AS] ⇨ 7: DELETE

* The commands enclosed in square brackets ([ ]) are “hidden” until you make a selection from the NEW ARB command to initiate a new edit session.

D: SYStem MENU

1: OUT TERM ⇨ 2: POWER ON ⇨ 3: ERROR ⇨ 4: TEST ⇨ 5: COMMA ⇨ 6: REVISION

E: Input / Output MENU

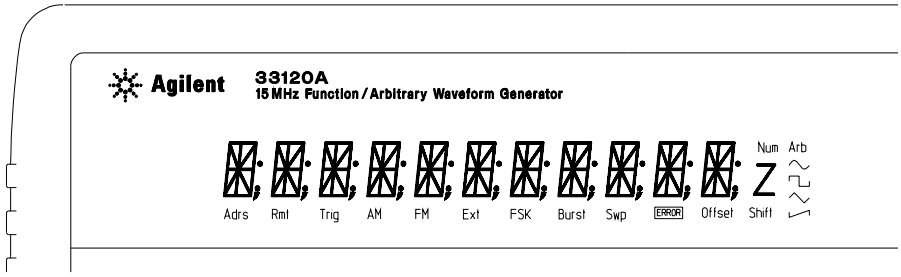
1: HPIB ADDR ⇨ 2: INTERFACE ⇨ 3: BAUD RATE ⇨ 4: PARITY ⇨ 5: LANGUAGE

F: CALibration MENU*

1: SECURED or [1: UNSECURED] ⇨ [2: CALIBRATE] ⇨ 3: CAL COUNT ⇨ 4: MESSAGE

* The commands enclosed in square brackets ([ ]) are “hidden” unless the function generator is UNSECURED for calibration.

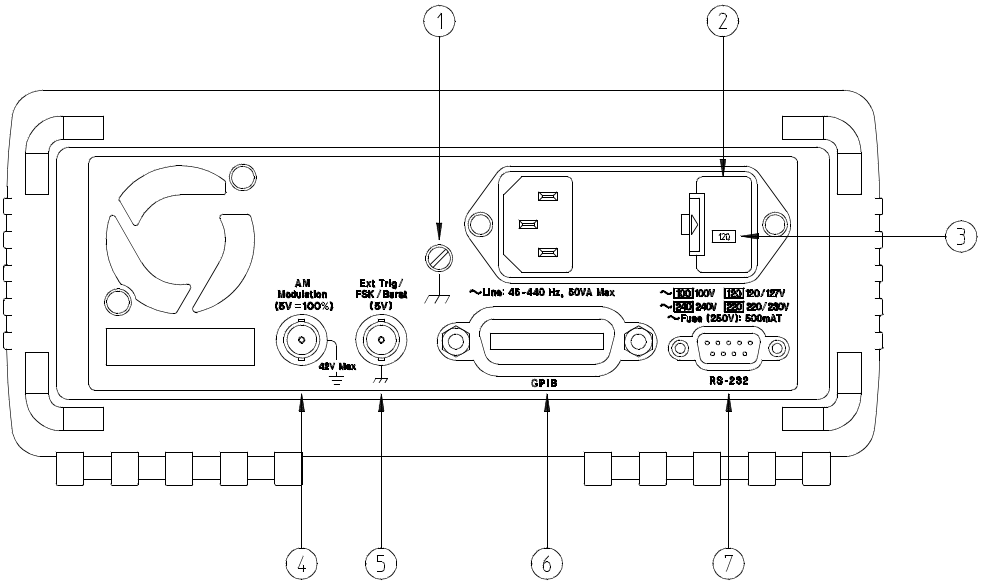
Display Annunciators



Adrs	Function generator is addressed to listen or talk over a remote interface.
Rmt	Function generator is in remote mode (remote interface).
Trig	Function generator is waiting for a single trigger or external trigger (Burst, Sweep).
AM	AM modulation is enabled.
FM	FM modulation is enabled.
Ext	Function generator is set for an external modulation source (AM, FSK, Burst).
FSK	FSK (frequency-shift keying) modulation is enabled.
Burst	Burst modulation is enabled.
Swp	Sweep mode is enabled.
ERROR	Hardware or remote interface command errors are detected.
Offset	The waveform is being output with an offset voltage.
Shift	"Shift" key has been pressed. *Press "Shift" again to turn off.*
Num	"Enter Number" mode is enabled. *Press "Shift-Cancel" to disable.*
Arb	Arbitrary waveform function is enabled.
∿	Sine waveform function is enabled.
⊓	Square waveform function is enabled.
⩘	Triangle waveform function is enabled.
◿	Ramp waveform function is enabled.

To review the display annunciators, hold down the Shift key as you turn on the function generator.

The Rear Panel at a Glance



1 Chassis ground
2 Power-line fuse-holder assembly
3 Power-line voltage setting
4 AM modulation input terminal
5 External Trigger / FSK / Burst modulation input terminal
6 GPIB (IEEE-488) interface connector
7 RS-232 interface connector

Use the front-panel Input / Output Menu to:

- Select the GPIB or RS-232 interface (see chapter 4 in User's Guide).
- Set the GPIB bus address (see chapter 4 in User's Guide).
- Set the RS-232 baud rate and parity (see chapter 4 in User's Guide).

In This Book

Specifications Chapter 1 lists the function generator's specifications and describes how to interpret these specifications.

Quick Start Chapter 2 prepares the function generator for use and helps you get familiar with a few of its front-panel features.

Front-Panel Menu Operation Chapter 3 introduces you to the front-panel menu and describes some of the function generator's menu features.

Calibration Procedures Chapter 4 provides calibration, verification, and adjustment procedures for the function generator.

Theory of Operation Chapter 5 describes block and circuit level theory related to the operation the function generator.

Service Chapter 6 provides guidelines for returning your function generator to Agilent for servicing, or for servicing it yourself.

Replaceable Parts Chapter 7 contains a detailed parts lists of the function generator.

Schematics Chapter 8 contains the function generator's block diagram, schematics, disassembly drawings, and component locator drawings.

For information on using the Phase-Lock Option for the 33120A, refer to the User's and Service Guide included with the Option 001.

*If you have questions relating to the operation of the 33120A, call **1-800-452-4844** in the United States, or contact your nearest Agilent Technologies Sales Office.*

If you believe your 33120A has failed, refer to "Operating Checklist", "Types of Service Available", and "Repackaging for Shipment" at the beginning of chapter 6.

Contents

Chapter 4 Calibration Procedures *(continued)*

Chapter 5 Theory of Operation

Chapter 6 Service

Chapter 7 Replaceable Parts

Chapter 8 Schematics

Specifications

WAVEFORMS

Standard Waveforms: Sine, Square, Triangle, Ramp, Noise, DC volts, Sine(x)/x, Negative Ramp, Exponential Rise, Exponential Fall, Cardiac

Arbitrary Waveforms:

Waveform Length:	8 to 16,000 points
Amplitude Resolution:	12 bits (including sign)
Sample Rate:	40 MSa / sec
Non-Volatile Memory:	Four 16,000-point waveforms

FREQUENCY CHARACTERISTICS

Sine:	100 μHz – 15 MHz
Square:	100 μHz – 15 MHz
Triangle:	100 μHz – 100 kHz
Ramp:	100 μHz – 100 kHz
Noise (Gaussian)**:**	10 MHz bandwidth
Arbitrary Waveforms:	
8 to 8,192 points:	100 μHz – 5 MHz
8,193 to 12,287 points:	100 μHz – 2.5 MHz
12,288 to 16,000 points:	100 μHz – 200 kHz

Resolution: 10 μHz or 10 digits

Accuracy: 10 ppm in 90 days, 20 ppm in 1 year, 18°C – 28°C

Temperature Coefficient: < 2 ppm / °C

Aging: < 10 ppm / yr

SINEWAVE SPECTRAL PURITY (into 50Ω)

Harmonic Distortion

DC to 20 kHz:	-70 dBc
20 kHz to 100 kHz:	-60 dBc
100 kHz to 1 MHz:	-45 dBc
1 MHz to 15 MHz:	-35 dBc

Total Harmonic Distortion

DC to 20 kHz:	< 0.04%

Spurious (non-harmonic)

Output (DC to 1 MHz):	< -65 dBc
Output (> 1 MHz):	< -65 dBc + 6 dB/octave

Phase Noise: < -55 dBc in a 30 kHz band

SIGNAL CHARACTERISTICS

Squarewave

Rise/Fall Time:	< 20 ns
Overshoot:	< 4%
Asymmetry:	1% + 5 ns
Duty Cycle:	20% to 80% *(to 5 MHz)*
	40% to 60% *(to 15 MHz)*

Triangle, Ramp, Arb

Rise/Fall Time:	40 ns *(typical)*
Linearity:	< 0.1% of peak output
Settling Time:	< 250 ns to 0.5% of final value
Jitter:	< 25 ns

OUTPUT CHARACTERISTICS (1)

Amplitude (into 50Ω): (2)	50 mVpp – 10 Vpp
Accuracy (at 1 kHz):	± 1% of specified output
Flatness	(sine wave relative to 1 kHz)
< 100 kHz:	± 1% (0.1 dB)
100 kHz to 1 MHz:	± 1.5% (0.15 dB)
1 MHz to 15 MHz:	± 2% (0.2 dB) Ampl ≥ 3Vrms
1 MHz to 15 MHz:	± 3.5% (0.3 dB) Ampl < 3Vrms
Offset (into 50Ω): (3)	± 5 Vpk ac + dc
Accuracy: (4)	± 2% of setting + 2 mV

Output Impedance: 50 ohms fixed

Resolution: 3 digits, Amplitude and Offset

Output Units: Vpp, Vrms, dBm

Isolation: 42 Vpk maximum to earth

Protection: Short-circuit protected
± 15 Vpk overdrive < 1 minute

(1) Add 1/10th of output amplitude and offset specification per °C for operation outside of 18°C to 28°C range (1-year specification).

(2) 100 mVpp – 20 Vpp amplitude into open-circuit load.

(3) Offset ≤ 2 X peak-to-peak amplitude.

(4) For square wave outputs, add 2% of output amplitude additional error.

MODULATION CHARACTERISTICS

AM Modulation

Carrier -3 dB Freq:	10 MHz *(typical)*
Modulation:	Any internal waveform plus Arb
Frequency:	10 mHz to 20 kHz (± 0.05% to 2.5 kHz, then decreases linearly to ± 0.4% at upper limit)
Depth:	0% to 120%
Source:	Internal / External

FM Modulation

Modulation:	Any internal waveform plus Arb
Frequency:	10 mHz to 10 kHz (± 0.05% to 600 Hz, then decreases linearly to ± 0.8% at upper limit)
Peak Deviation:	10 mHz to 15 MHz
Source:	Internal Only

Burst Modulation

Carrier Frequency:	5 MHz max.
Count:	1 to 50,000 cycles, or Infinite
Start Phase:	-360° to +360°
Internal Rate:	10 mHz to 50 kHz ±1%
Gate Source:	Internal or External Gate (1)
Trigger Source:	Single, External, or Internal Rate

FSK Modulation

Frequency Range:	10 mHz to 15 MHz (± 0.05% to 600 Hz, then decreases linearly to ± 4% at upper limit)
Internal Rate:	10 mHz to 50 kHz
Source:	Internal / External (1 MHz max.)

FREQUENCY SWEEP

Type:	Linear or Logarithmic
Direction:	Up or Down
Start F / Stop F:	10 mHz to 15 MHz
Time:	1 ms to 500 sec ±0.1%
Source:	Single, External, or Internal

REAR-PANEL INPUTS

External AM Modulation:	± 5 Vpk = 100% Modulation 5 kΩ Input Resistance
External Trigger/FSK Burst Gate: (1)	TTL (low true)
Latency:	1.3 µs
Jitter:	25 ns

SYSTEM CHARACTERISTICS

Configuration Times (2)

Function Change: (3)	80 ms
Frequency Change: (3)	30 ms
Amplitude Change:	30 ms
Offset Change:	10 ms
Select User Arb:	100 ms
Modulation Parameter Change:	< 350 ms

Arb Download Times over GPIB:

Arb Length	*Binary*	*ASCII Integer*	*ASCII Real* (4)
16,000 points	8 sec	81 sec	100 sec
8,192 points	4 sec	42 sec	51 sec
4,096 points	2.5 sec	21 sec	26 sec
2,048 points	1.5 sec	11 sec	13 sec

Arb Download Times over RS-232 at 9600 Baud: (5)

Arb Length	*Binary*	*ASCII Integer*	*ASCII Real* (6)
16,000 points	35 sec	101 sec	134 sec
8,192 points	18 sec	52 sec	69 sec
4,096 points	10 sec	27 sec	35 sec
2,048 points	6 sec	14 sec	18 sec

(1) Trigger source ignored when External Gate is selected.

(2) Time to change parameter and output the new signal.

(3) Modulation or sweep off.

(4) Times for 5-digit and 12-digit numbers.

(5) For 4800 baud, multiply the download times by two; For 2400 baud, multiply the download times by four, etc.

(6) Time for 5-digit numbers. For 12-digit numbers, multiply the 5-digit numbers by two.

GENERAL SPECIFICATIONS

Power Supply: (1) 100V / 120V / 220V / 240V ±10% *(switch selectable)*

Power-Line Frequency: 50 Hz to 60 Hz ±10% and 400 Hz ±10%. Automatically sensed at power-on.

Power Installation: CAT II

Power Consumption: 50 VA peak (28 W average)

Operating Environment: 0°C to 55°C
80% Relative Humidity to 40°C
Indoor or sheltered location

Storage Environment: -40°C to 70°C

State Storage Memory: Power-off state automatically saved. Three (3) User-Configurable Stored States, Arbitrary waveforms stored separately.

Dimensions (W x H x D)
Bench Top: 254.4 mm x 103.6 mm x 374 mm
Rack Mount: 212.6 mm x 88.5 mm x 348.3 mm

Weight: 4 kg (8.8 lbs)

(1) For 400 Hz operation at 120 Vac, use the 100 Vac line-voltage setting.

Safety Designed to: EN61010, CSA1010, UL-1244

EMC: EN61326, 1:1997 + 1A:1998

Vibration and Shock: MIL-T-28800E, Type III, Class 5 (data on file)

Acoustic Noise: 30 dBa

Warm-Up Time: 1 hour

Warranty: 3 years standard

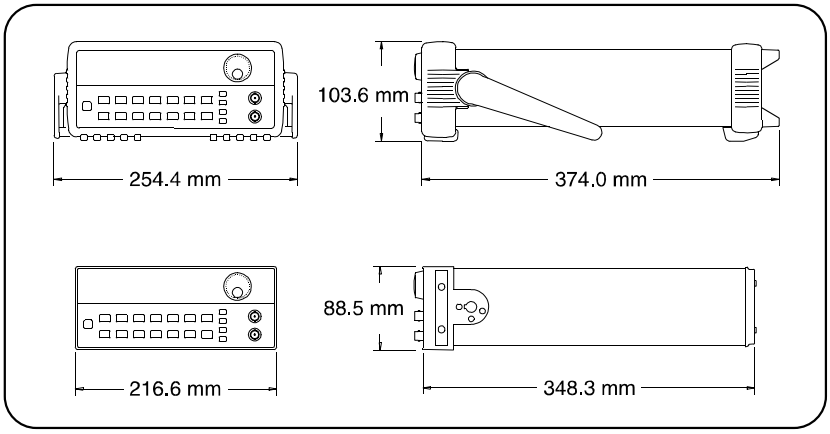
Remote Interface: IEEE-488 and RS-232 standard

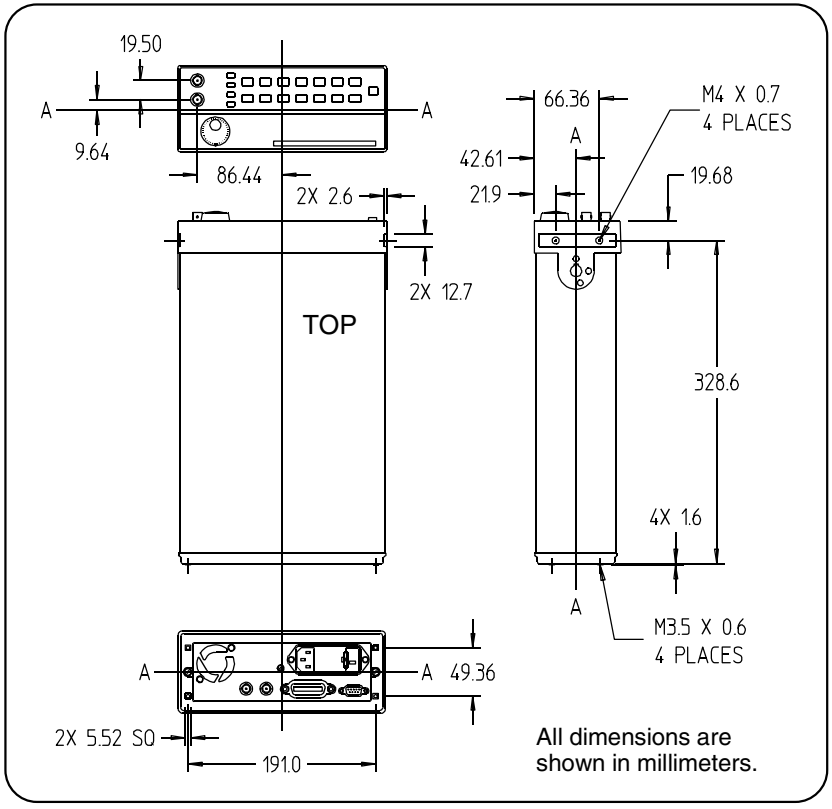
Programming Language: SCPI-1993, IEEE-488.2

Accessories Included: User's Guide, Service Guide, Quick Reference Card, IntuiLink Arb software, RS-232 cable, Test Report, and power cord.

 N10149

PRODUCT DIMENSIONS





Quick Start

Quick Start

One of the first things you will want to do with your function generator is to become acquainted with its front panel. We have written the exercises in this chapter to prepare the function generator for use and help you get familiar with some of the front-panel operations.

The front panel has two rows of keys to select various functions and operations. Most keys have a *shifted* function printed in *blue* above the key. To perform a shifted function, press [Shift] (the **Shift** annunciator will turn on). Then, press the key that has the desired label above it. For example, to select the AM (amplitude modulation) function, press [Shift] [AM] (the shifted version of the [~] key).

If you accidentally press [Shift], just press it again to turn off the **Shift** annunciator.

Most keys also have a number printed in *green* next to the key. To enable the number mode, press [Enter Number] (the **Num** annunciator will turn on). Then, press the keys that have the desired numbers printed next to them. For example, to select the number "10", press [Enter Number] [1] [0] (next to the [~] and [Recall] keys).

If you accidentally press [Enter Number], just press [Shift] [Cancel] to turn off the **Num** annunciator.

To prepare the function generator for use

The following steps help you verify that the function generator is ready for use.

1 Check the list of supplied items.

Verify that you have received the following items with your function generator. If anything is missing, contact your nearest Agilent Technologies Sales Office.

- ☐ One power cord.
- ☐ One RS-232 serial cable.
- ☐ One *User's Guide*.
- ☑ This *Service Guide*.
- ☐ One folded *Quick Reference* card.
- ☐ Certificate of Calibration.
- ☐ Agilent IntuiLink Arb Waveform Generation Software.

2 Connect the power cord and turn on the function generator.

If the function generator does not turn on, see chapter 6 for troubleshooting information. The front-panel display will light up while the function generator performs its power-on self-test. The GPIB bus address is displayed. Notice that the function generator powers up in the *sine wave* function at 1 kHz with an amplitude of 100 mV peak-to-peak (into a 50Ω termination).

To review the power-on display with all annunciators turned on, hold down Shift *as you turn on the function generator.*

3 Perform a *complete* self test.

The *complete* self-test performs a more extensive series of tests than those performed at power-on. Hold down Shift as you press the Power switch to turn on the function generator; *hold down the key for more than 5 seconds*. The self-test will begin when you release the key.

If the self-test is successful, "PASS" is displayed on the front panel. If the self-test is not successful, "FAIL" is displayed and the **ERROR** annunciator turns on. See chapter 6 for instructions on returning the function generator to Agilent for service.

If the function generator does not turn on

Use the following steps to help solve problems you might experience when turning on the function generator. If you need more help, see chapter 6 for instructions on returning the function generator to Agilent for service.

1 Verify that there is ac power to the function generator.

First, verify that the function generator's Power switch is in the "On" position. Also, make sure that the power cord is firmly plugged into to the power module on the rear panel. You should also make sure that the power source you plugged the function generator into is energized.

2 Verify the power-line voltage setting.

The line voltage is set to the proper value for your country when the function generator is shipped from the factory. Change the voltage setting if it is not correct. The settings are: 100, 120, 220, or 240 Vac (for 230 Vac operation, use the 220 Vac setting).

See the next page if you need to change the line-voltage setting.

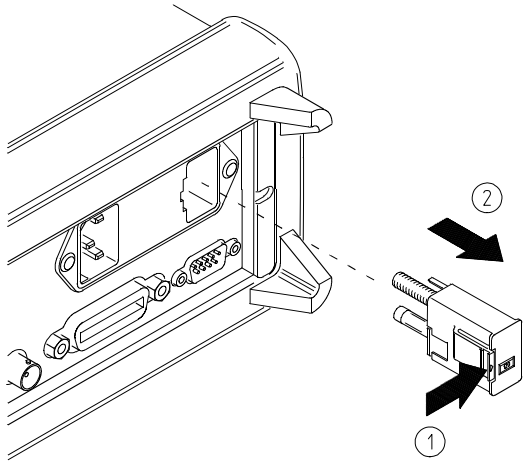
3 Verify that the power-line fuse is good.

The function generator is shipped from the factory with a 500 mAT fuse installed. This is the correct fuse for all line voltages.

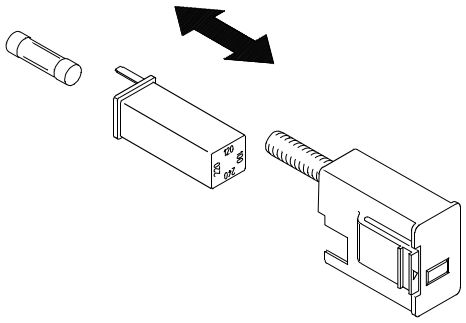
See the next page if you need to change the power-line fuse.

To replace the 500 mAT fuse, order Agilent part number 2110-0458.

1 ***Remove the power cord***. Remove the fuse-holder assembly from the rear panel.

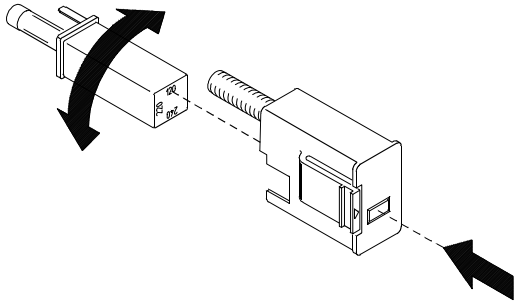


2 Remove the line-voltage selector from the assembly.



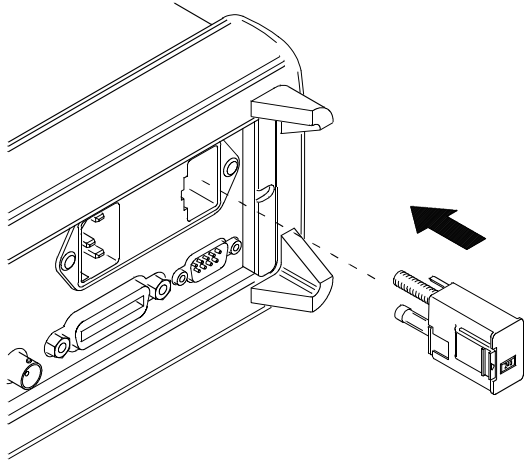
Fuse: 500 mAT (for all line voltages)
Part Number: 2110-0458

3 Rotate the line-voltage selector until the correct voltage appears in the window.



100, 120, 220 (230), or 240 Vac

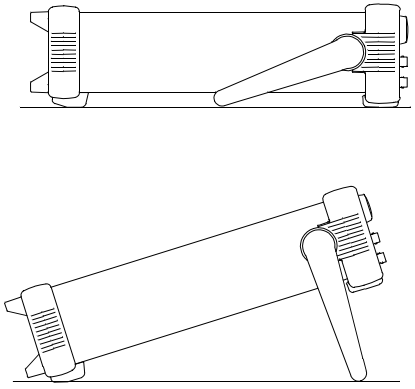
4 Replace the fuse-holder assembly in the rear panel.



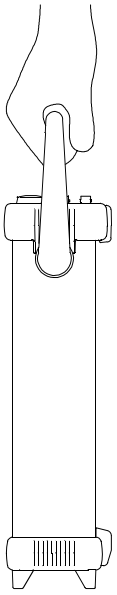
Verify that the correct line voltage is selected and the power-line fuse is good.

To adjust the carrying handle

To adjust the position, grasp the handle by the sides and *pull outward*. Then, rotate the handle to the desired position.



Bench-top viewing positions



Carrying position

To set the output frequency

At power-on, the function generator outputs a sine wave at 1 kHz with an amplitude of 100 mV peak-to-peak (into a 50Ω termination).
The following steps show you how to change the frequency to 1.2 MHz.

Freq

1 Enable the *frequency modify* mode.

The displayed frequency is either the power-on value or the previous frequency selected. When you change functions, the same frequency is used if the present value is valid for the new function.

```
1.000,000,0 KHz
```

Enter Number

2 Enter the magnitude of the desired frequency. [1]

1 . 2

Notice that the **Num** annunciator turns on and "ENTER NUM" flashes on the display, indicating that the number mode is enabled.

```
1.2
```

To cancel the number mode, press Shift Cancel .

^ MHz
m Vpp

3 Set the units to the desired value.

The units are selected using the arrow keys on the right side of the front panel. As soon as you select the units, the function generator outputs the waveform with the displayed frequency. *To turn off the flashing digit, move the cursor to the left of the display using the arrow keys.*

```
1.200,000,0 MHz
```

[1] *You can also use the knob and arrow keys to enter a number.*

To set the output amplitude

At power-on, the function generator outputs a sine wave with an amplitude of 100 mV peak-to-peak (into a 50Ω termination).
The following steps show you how to change the amplitude to 50 mVrms.

Ampl

1 Enable the *amplitude modify* mode.

The displayed amplitude is either the power-on value or the previous amplitude selected. When you change functions, the same amplitude is used if the present value is valid for the new function.

```
100.0   mVPP
```

Enter Number

2 Enter the magnitude of the desired amplitude. [1]

5 0

Notice that the **Num** annunciator turns on and "ENTER NUM" flashes on the display, indicating that the number mode is enabled.

```
50
```

To cancel the number mode, press Shift Cancel .

Shift

3 Set the units to the desired value.

∨ kHz
m Vrms

The units are selected using the arrow keys on the right side of the front panel. As soon as you select the units, the function generator outputs the waveform with the displayed amplitude. *To turn off the flashing digit, move the cursor to the left of the display using the arrow keys.*

```
50.00   mVRMS
```

[1] *You can also use the knob and arrow keys to enter a number.*

To set a dc offset voltage

At power-on, the function generator outputs a sine wave with a dc offset voltage of 0 volts (into a 50Ω termination). *The following steps show you how to change the offset to –1.5 mVdc.*

Offset

1 Enable the *offset modify* mode.

The displayed offset voltage is either the power-on value or the previous offset selected. When you change functions, the same offset is used if the present value is valid for the new function.

```
+0.000    VDC
```

Enter Number

2 Enter the magnitude of the desired offset. [1]

± 1 . 5

Notice that the **Num** annunciator turns on and "ENTER NUM" flashes on the display, indicating that the number mode is enabled. Notice that ± toggles the displayed value between **+** and **–** .

```
-1.5
```

To cancel the number mode, press Shift Cancel .

Shift

3 Set the units to the desired value.

∨ kHz
m Vrms

At this point, the function generator outputs the waveform with the displayed offset. Notice that the **Offset** annunciator turns on, indicating that the waveform is being output with an offset. The annunciator will turn on when the offset is any value other than 0 volts. *To turn off the flashing digit, move the cursor to the left of the display using the arrow keys.*

```
-01.50    mVDC
```

[1] *You can also use the knob and arrow keys to enter a number.*

To set the duty cycle

Applies only to square waves. At power-on, the duty cycle for square waves is 50%. You can adjust the duty cycle for a square waveform from 20% to 80%, in increments of 1% (for frequencies above 5 MHz, the range is 40% to 60%). *The following steps show you how to change the duty cycle to 45%.*

[⎍] **1 Select the square wave function.**

Notice that the [⎍] annunciator turns on, indicating that the square wave function is enabled.

[Shift] [% Duty] **2 Enable the *duty cycle modify* mode.**

The displayed duty cycle is either the power-on value or the previous value selected.

```
50 % DUTY
```

This message appears on the display for approximately 10 seconds. Repeat this step as needed.

[Enter Number] **3 Enter the desired duty cycle.** [1]

[4] [5] Notice that the **Num** annunciator turns on and "ENTER NUM" flashes on the display, indicating that the number mode is enabled.

```
45
```

To cancel the number mode, press [Shift] [Cancel] .

[Enter] **4 Output the waveform with the displayed duty cycle.**

```
45 % DUTY
```

[1] *You can also use the knob and arrow keys to enter a number.*

To output a stored arbitrary waveform

There are five built-in arbitrary waveforms stored in non-volatile memory for your use. You can output these waveforms directly from non-volatile memory. *The following steps show you how to output an "exponential rise" waveform from memory.*

Shift Arb List **1 Display the list of arbitrary waveforms.**

The list contains the five built-in arbitrary waveforms (sinc, negative ramp, exponential rise, exponential fall, and cardiac). The list may also contain up to four user-defined arbitrary waveform names. The first choice on this level is "SINC".

This message appears on the display for approximately 10 seconds. Repeat this step as needed.

> > **2 Move across to the EXP_RISE choice.** [1]

Enter **3 Select and output the displayed arbitrary waveform.**

Notice that the **Arb** annunciator turns on, indicating that the output is an arbitrary waveform. The waveform is output using the present settings for frequency, amplitude, and offset unless you change them.

The selected waveform is now assigned to the Arb *key. Whenever you press this key, the selected arbitrary waveform is output.*

[1] *You can also use the knob to scroll left or right through the choices in the list.*

To output a dc voltage

In addition to generating waveforms, you can also output a dc voltage in the range ± 5 Vdc (into a 50Ω termination). *The following steps show you how to output +155 mVdc.*

1 Press the Offset **key and *hold it down for more than 2 seconds*.**

To enter the dc voltage mode, press the Offset key or any key in the top row of function keys and ***hold it down for more than 2 seconds***. The displayed voltage is either the power-on value or the previous offset voltage selected.

```
      DCV
```

```
 +0.000    VDC
```

Enter Number

2 Enter the magnitude of the desired voltage. [1]

1 5 5

Notice that the **Num** annunciator turns on and "ENTER NUM" flashes on the display, indicating that the number mode is enabled.

```
 155
```

To cancel the number mode, press Shift Cancel .

Shift

3 Set the units to the desired value.

∨ kHz
m Vrms

At this point, the function generator outputs the displayed dc voltage. Notice that the **Offset** annunciator turns on (all other annunciators are off), indicating that a dc voltage is being output. The annunciator will turn on when the offset is any value other than 0 volts.

```
 +155.0    mVDC
```

[1] *You can also use the knob and arrow keys to enter a number.*

To store the instrument state

You can store up to three different instrument states in non-volatile memory. This enables you to recall the entire instrument configuration with just a few key presses from the front panel. *The following steps show you how to store and recall a state.*

1 Set up the function generator to the desired configuration.

The state storage feature "remembers" the function, frequency, amplitude, dc offset, duty cycle, as well as any modulation parameters.

Shift Store **2 Turn on the state storage mode.**

Three memory locations (numbered 1, 2, and 3) are available to store instrument configurations. The instrument configuration is stored in *non-volatile* memory and is remembered when power has been off.

```
STORE  1
```

This message appears on the display for approximately 10 seconds. Repeat this step as needed.

^ **3 Store the instrument state in memory location "2".** [1]

Use the up and down arrow keys to select the memory location.

```
STORE  2
```

To cancel the store operation, press Shift Store *again or let the display time-out after 10 seconds.*

Enter **4 Save the instrument state.**

The instrument state is now stored. To recall the stored state, turn to the next page.

[1] *You can also use the knob or "enter number" mode to enter a memory location.*

To verify that the state was stored properly, you can turn the power off before recalling the state.

Recall **5 Recall the stored instrument state.**

To recall the stored state, you must use the same memory location used previously to store the state. Use the up and down arrow keys to change the displayed storage location.

To cancel the restore operation, press Recall *again.*

This message appears on the display for approximately 10 seconds. Repeat this step as needed.

Enter **6 Restore the instrument state.**

The function generator should now be configured in the same state as when you stored the setup on the previous page.

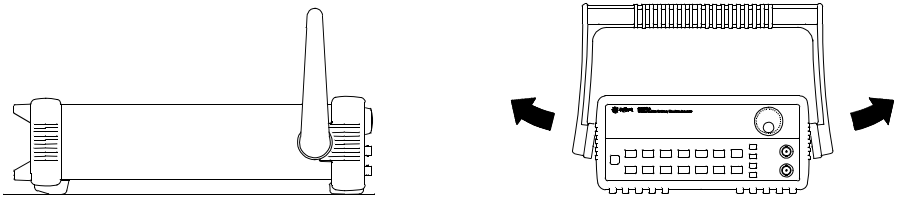
When power is turned off, the function generator automatically stores its state in memory location "0". You can recall the power-down state, but you cannot store the state to location "0" from the front panel.

Use the POWER ON ENABLE command in the SYS MENU to automatically recall the power-down state when power is turned on. See chapter 3 for more information on using the front-panel menus.

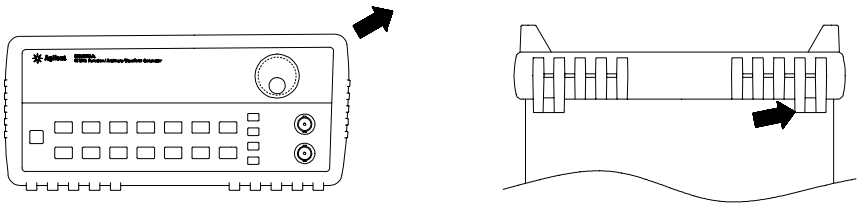
To rack mount the function generator

You can mount the function generator in a standard 19-inch rack cabinet using one of three optional kits available. Instructions and mounting hardware are included with each rack-mounting kit.
Any Agilent *System II* instrument of the same size can be rack-mounted beside the 33120A Function Generator.

Remove the carrying handle, and the front and rear rubber bumpers, before rack-mounting the function generator.



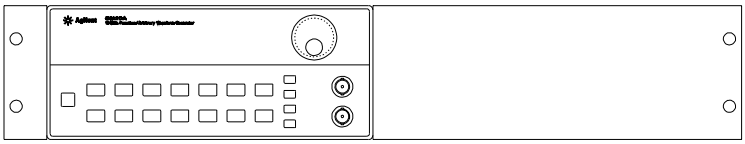
To remove the handle, rotate it to the vertical position and pull the ends outward.



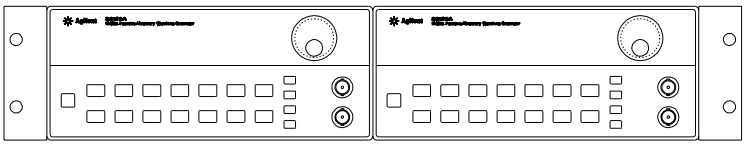
Front

Rear (bottom view)

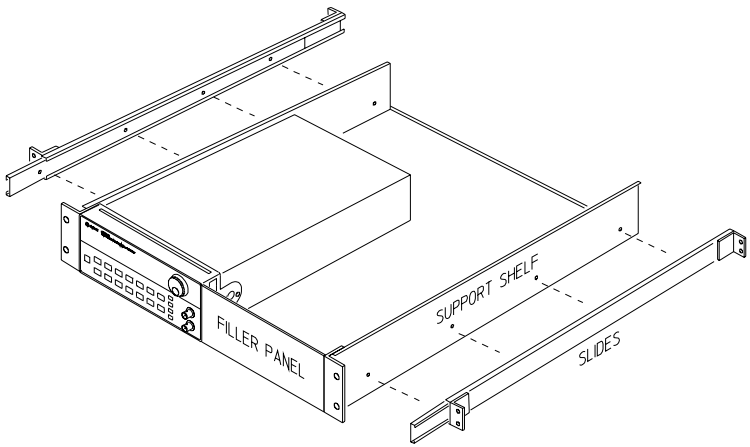
To remove the rubber bumper, stretch a corner and then slide it off.



To rack mount a single instrument, order adapter kit 5063-9240.



To rack mount two instruments side-by-side, order lock-link kit 5061-9694 and flange kit 5063-9212.



To install one or two instruments in a sliding support shelf, order shelf 5063-9255, and slide kit 1494-0015 (for a single instrument, also order filler panel 5002-3999).

Front-Panel Menu Operation

Front-Panel Menu Operation

By now you should be familiar with some of the basic features of the front panel. Chapter 2 shows you how to prepare the function generator for use and describes a few of the front-panel features. If you are not familiar with this information, we recommend that you read chapter 2, "Quick Start," starting on page 19.

Chapter 3 introduces you to the use of the front-panel menu. This chapter *does not* give a detailed description of every front-panel key or menu operation. It does, however, give you an overview of front-panel menu operations related to verification, adjustment and service. See chapter 3 "Features and Functions" in the *User's Guide* for a complete discussion of the function generator's capabilities and operation.

> *If you purchased the Phase-Lock Option for the 33120A, an additional menu* (**G: PHASE MENU**) *is available from the front panel. For information on using the Phase-Lock Option, refer to the User's and Service Guide included with Option 001.*

Front-panel menu reference

A: MODulation MENU

1: AM SHAPE ⇨ 2: AM SOURCE ⇨ 3: FM SHAPE ⇨ 4: BURST CNT ⇨ 5: BURST RATE ⇨

⇨ 6: BURST PHAS ⇨ 7: BURST SRC ⇨ 8: FSK FREQ ⇨ 9: FSK RATE ⇨ 10: FSK SRC

1: AM SHAPE	Selects the shape of the AM modulating waveform.
2: AM SOURCE	Enables or disables the internal AM modulating source.
3: FM SHAPE	Selects the shape of the FM modulating waveform.
4: BURST CNT	Sets the number of cycles per burst (1 to 50,000 cycles).
5: BURST RATE	Sets the burst rate in Hz for an internal burst source.
6: BURST PHAS	Sets the starting phase angle of a burst (-360 to +360 degrees).
7: BURST SRQ	Selects an internal or external gate source for burst modulation.
8: FSK FREQ	Sets the FSK “hop” frequency.
9: FSK RATE	Selects the internal FSK rate between the carrier and FSK frequency.
10: FSK SRC	Selects an internal or external source for the FSK rate.

B: SWP (Sweep) MENU

1: START F ⇨ 2: STOP F ⇨ 3: SWP TIME ⇨ 4: SWP MODE

1: START F	Sets the start frequency in Hz for sweeping.
2: STOP F	Sets the stop frequency in Hz for sweeping.
3: SWP TIME	Sets the repetition rate in seconds for sweeping.
4: SWP MODE	Selects linear or logarithmic sweeping.

C: EDIT MENU *

1: NEW ARB ⇨ 2: POINTS ⇨ [3: LINE EDIT] ⇨ [4: POINT EDIT] ⇨ [5: INVERT] ⇨ [6: SAVE AS] ⇨ 7:DELETE

1: NEW ARB	Initiates a new arb waveform or loads the selected arb waveform.
2: POINTS	Sets the number of points in a new arb waveform (8 to 16,000 points).
3: LINE EDIT	Performs a linear interpolation between two points in the arb waveform.
4: POINT EDIT	Edits the individual points of the selected arb waveform.
5: INVERT	Inverts the selected arb waveform by changing the sign of each point.
6: SAVE AS	Saves the current arb waveform in non-volatile memory.
7: DELETE	Deletes the selected arb waveform from non-volatile memory.

* The commands enclosed in square brackets ([ ]) are “hidden” until you make a selection from the NEW ARB command to initiate a new edit session.

D: SYStem MENU

1: OUT TERM ⇨ 2: POWER ON ⇨ 3: ERROR ⇨ 4: TEST ⇨ 5: COMMA ⇨ 6:REVISION

1: OUT TERM	Selects the output termination (50Ω or high impedance).
2: POWER ON	Enables or disables automatic power-up in power-down state "0".
3: ERROR	Retrieves errors from the error queue (up to 20 errors).
4: TEST	Performs a complete self-test.
5: COMMA	Enables or disables a comma separator between digits on the display.
6: REVISION	Displays the function generator's firmware revision codes.

E: Input / Output MENU

1: HPIB ADDR ⇨ 2: INTERFACE ⇨ 3: BAUD RATE ⇨ 4: PARITY ⇨ 5: LANGUAGE

1: HPIB ADDR	Sets the GPIB bus address (0 to 30).
2: INTERFACE	Selects the GPIB or RS-232 interface.
3: BAUD RATE	Selects the baud rate for RS-232 operation.
4: PARITY	Selects even, odd, or no parity for RS-232 operation.
5: LANGUAGE	Verifies the interface language: SCPI.

F: CALibration MENU *

1: SECURED ⇨ [1: UNSECURED] ⇨ [2: CALIBRATE] ⇨ 3: CAL COUNT ⇨ 4: MESSAGE

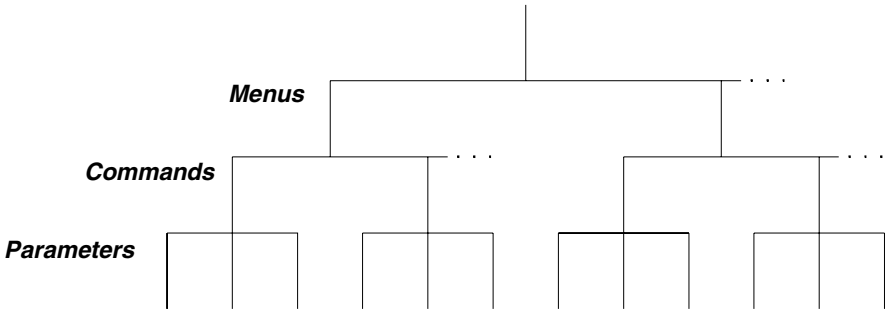
1: SECURED	The function generator is secured against calibration; enter code to unsecure.
1: UNSECURED	The function generator is unsecured for calibration; enter code to secure.
2: CALIBRATE	Performs individual calibrations; must be UNSECURED.
3: CAL COUNT	Reads the total number of times the function generator has been calibrated.
4: MESSAGE	Reads the calibration string (up to 11 characters) entered from remote.

* The commands enclosed in square brackets ([ ]) are "hidden" unless the function generator is UNSECURED for calibration.

A front-panel menu tutorial

This section is a step-by-step tutorial which shows you how to use the front-panel menu. We recommend that you spend a few minutes with this tutorial to get comfortable with the structure and operation of the menu before attempting verification, calibration, or adjustments.

The menu is organized in a top-down tree structure with three levels (*menus*, *commands*, and *parameters*). You move down [∨] or up [∧] the menu tree to get from one *level* to the next. Each of the three levels has several horizontal *choices* which you can view by moving left [<] or right [>] .



The menu is organized in a top-down tree structure with three levels.

- To *turn on* the menu, press [Shift] [Menu On/Off] .
- To *turn off* the menu, press [Shift] [Menu On/Off] .
- To *execute* a menu command, press [Enter] .
- To *recall* the last menu command that was executed, press [Shift] [Recall Menu] .
- To *turn off* the menu at any time without saving changes, press [Shift] [Cancel] .

Messages Displayed During Menu Use

TOP OF MENU You pressed [∧] while on the "MENUS" level; this is the top level of the menu and you cannot go any higher.

To turn off the menu, press [Shift] [Menu On/Off] . *To move across the choices on a level, press* [<] or [>] . *To move down a level, press* [∨] .

MENUS You are on the "MENUS" level. Press [<] or [>] to view the choices.

COMMANDS You are on the "COMMANDS" level. Press [<] or [>] to view the command choices within the selected menu group.

PARAMETER You are on the "PARAMETER" level. Press [<] or [>] to view and edit the parameter for the selected command.

MENU BOTTOM You pressed [∨] while on the "PARAMETER" level; this is the bottom level of the menu and you cannot go any lower.

To turn off the menu, press [Shift] [Menu On/Off] . To move up a level, press [∧] .

ENTERED The change made on the "PARAMETER" level is saved. This is displayed after you press [Enter] (Menu Enter) to execute the command.

MIN VALUE The value you specified on the "PARAMETER" level is too small for the selected command. The minimum value allowed is displayed for you to edit.

MAX VALUE The value you specified on the "PARAMETER" level is too large for the selected command. The maximum value allowed is displayed for you to edit.

EXITING You will see this message if you turn off the menu by pressing [Shift] [Menu On/Off] or [Shift] [Cancel] . You did not edit any values on the "PARAMETER" level and changes were NOT saved.

NOT ENTERED You will see this message if you turn off the menu by pressing [Shift] [Menu On/Off] or [Shift] [Cancel] . You did some editing of parameters but the changes were NOT saved. Press [Enter] (Menu Enter) to save changes made on the "PARAMETER" level.

Menu Example 1

The following steps show you how to turn on the menu, move up and down between levels, move across the choices on each level, and turn off the menu. *In this example, you will restore the function generator to the power-on default state. This procedure is recommended before performing the verification procedures in chapter 4.*

Shift

1 Turn on the menu.

Menu On/Off

You enter the menu on the "MENUS" level. The MOD MENU is your first choice on this level.

```
A: MOD MENU
```

> > >

2 Move across to the SYS MENU choice on this level. [1]

There are six menu group choices available on the "MENUS" level. Each choice has a letter prefix for easy identification (**A:** , **B:** , etc.).

```
D: SYS MENU
```

v

3 Move down to the "COMMANDS" level within the SYS MENU.

The OUT TERM command is your first choice on this level.

```
1: OUT TERM
```

>

4 Move across to the POWER ON command on this level. [1]

There are six command choices available in the SYS MENU. Each choice on this level has a number prefix for easy identification (**1:** , **2:** , etc.).

```
2: POWER ON
```

[1] *You can also use the knob to scroll left or right through the choices on each level of the menu.*

v

5 Move down a level to the "PARAMETER" choices.

The first parameter choice is "DEFAULT" for the POWER ON command ("DEFAULT" is the factory setting and is stored in non-volatile memory).

```
DEFAULT
```

>

6 Move across to the "LAST STATE" choice. [1]

There are two parameter choices for POWER ON.

```
LAST STATE
```

Enter

7 Save the change and turn off the menu.

The function generator beeps and displays a message to show that the change is now in effect. You are then exited from the menu.

```
ENTERED
```

8 Cycle the power to restore the default values.

Turn the function generator OFF and then ON. The default output state will now be in effect (1 kHz sine wave, 100 mV peak-to-peak, 50Ω termination).

[1] *You can also use the knob to scroll left or right through the choices on each level of the menu.*

Menu Example 2

Some commands in the menu require that you enter a numeric parameter value. The following steps show you how to enter a number in the menu. *For this example, you will change the output amplitude.*

Ampl

1 Select amplitude adjustment

The function generator displays the current output amplitude.

```
100.0  mVPP
```

<

2 Move the flashing cursor over to edit the first digit.

The cursor movement wraps around.

```
100.0  mVPP
```

^ ^ ^

3 Increment the first digit until 300.0 mVPP is displayed.  [1]

The output amplitude of the function changes as you adjust the displayed value.

```
300.0  mVPP
```

[1] *You can also use the knob and arrow keys to enter a number.*

To select the output termination

The function generator has a fixed output impedance of 50 ohms on the *OUTPUT* terminal. You can specify whether **you** are terminating the output into a 50Ω load or an open circuit. Incorrect impedance matching between the source and load will result in an output amplitude or dc offset which does not match the specified value.

Shift

1 Turn on the menu.

Menu On/Off

```
A: MOD MENU
```

> > >

2 Move across to the SYS MENU choice on this level. [1]

```
D: SYS MENU
```

∨

3 Move down a level to the OUT TERM command.

```
1: OUT TERM
```

∨ >

4 Move down a level and then across to the HIGH Z choice. [1]

With the output termination set to "HIGH Z", the function generator allows you to set the unloaded (open circuit) output voltage.

```
HIGH Z
```

Enter

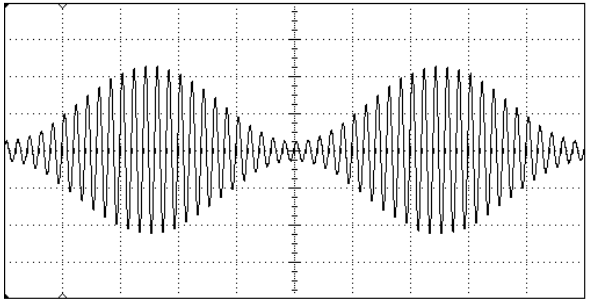
5 Save the change and turn off the menu.

The function generator beeps and displays a message to show that the change is now in effect. You are then exited from the menu.

[1] *You can also use the knob to scroll left or right through the choices on each level of the menu.*

To output a modulated waveform

A modulated waveform consists of a *carrier* and a *modulating* waveform. In AM (amplitude modulation), the amplitude of the carrier is varied by the amplitude of the modulating waveform. *For this example, you will output an AM waveform with 80% modulation depth. The carrier will be a 5 kHz sine wave and the modulating waveform will be a 200 Hz sine wave.*



1 Select the function, frequency, and amplitude of the carrier.

For the carrier waveform, you can select a sine, square, triangle, ramp, or arbitrary waveform. *For this example, select a **5 kHz** sine wave with an amplitude of **5 Vpp**.*

Shift AM

2 Select AM.

Notice that the **AM** annunciator turns on.

Shift

3 Use the menu to select the shape of the modulating waveform.

< Recall Menu

After you enable the AM function, the “recall menu” key will automatically take you to the AM SHAPE command in the MOD MENU.

```
1: AM SHAPE
```

[v]

4 Move down a level verify that "SINE" is selected.

For the modulating waveform, you can select a sine, square, triangle, ramp, noise, or arbitrary waveform. *For this example, you will modulate the carrier with a sine waveform.* Notice that the **AM** annunciator flashes, indicating that the displayed parameter is for AM.

```
SINE
```

[Enter]

5 Save the change and turn off the menu.

The modulating waveform is now a sine waveform.

```
ENTERED
```

[Shift] [Freq]

6 Set the modulating frequency to 200 Hz.

Notice that the **AM** annunciator flashes, indicating that the displayed frequency is the modulating frequency. Also notice that the modulating frequency is displayed with fewer digits than the carrier frequency.

```
MOD  200.0  Hz
```

This message appears on the display for approximately 10 seconds. Repeat this step as needed.

[Shift] [Level]

7 Set the modulation depth to 80%.

Notice that the **AM** annunciator flashes, indicating that the displayed percentage is the AM depth (also called *percent modulation*).

```
080  %  DEPTH
```

This message appears on the display for approximately 10 seconds. Repeat this step as needed.

At this point, the function generator outputs the AM waveform with the specified modulation parameters.

To unsecure the function generator for calibration

The function generator can use a calibration security code to prevent unauthorized or accidental calibration. This procedure shows you how to unsecure the function generator for calibration.

Shift

1 Turn on the menu.

Menu On/Off

```
A: MOD MENU
```

<

2 Move across to the CAL MENU choice on this level.

```
F: CAL MENU
```

v

3 Move down a level to the SECURED command.

```
1: SECURED
```

If the display shows UNSECURED, you do not need to perform this procedure to execute a calibration.

∨

4 Move down to the "parameters" level.

```
^000000:CODE
```

0 3 3

1 2 0

5 Unsecure the function generator by entering the security code.

ENTER

```
^033120:CODE
```

The security code is set to "HP33120" when the function generator is shipped from the factory. The security code is stored in *non-volatile* memory and *does not* change when the power has been off or after a remote interface reset.

To enter the security code from the front panel, enter only the six digits. To enter the security code from the remote interface, you may enter up to 12 characters. Use the knob or arrow keys to move left or right between digits. Use the up or down arrow keys to change the digits.

To re-secure the function generator following a calibration, perform this procedure again.

Additional information about the calibration security feature is given on page 64.

Calibration Procedures

Calibration Procedures

This chapter contains procedures for verification of the function generator's performance and adjustment (calibration). The chapter is divided into the following sections:

Closed-Case Electronic Calibration The function generator features closed-case electronic calibration since no internal mechanical adjustments are required for normal calibration. The function generator calculates correction factors based upon the input reference value you set. The new correction factors are stored in non-volatile memory until the next calibration adjustment is performed (non-volatile memory does not change when power has been off or after a remote interface reset).

Agilent Calibration Services

When your function generator is due for calibration, contact your local Agilent Service Center for a low-cost recalibration. The 33120A Function Generator is supported on automated calibration systems which allow Agilent to provide this service at competitive prices. Calibrations to MIL-STD-45662 are also available at competitive prices.

Calibration Interval

The function generator should be calibrated on a regular interval determined by the measurement accuracy requirements of your application. A 1- or 2-year interval is adequate for most applications. Agilent does not recommend extending calibration intervals beyond two years for any application.

Whatever calibration interval you select, Agilent recommends that complete re-adjustment should always be performed at the calibration interval. This will increase your confidence that the 33120A will remain within specification for the next calibration interval. This criteria for re-adjustment provides the best long-term stability. Performance data measured using this method can be used to extend future calibration intervals.

Time Required for Calibration

The 33120A can be automatically calibrated under computer control. With computer control you can perform the complete calibration procedure and performance verification tests in less than 15 minutes. Manual calibrations using the recommended test equipment will take approximately 45 minutes.

Automating Calibration Procedures

You can automate the complete verification and adjustment procedures outlined in this chapter if you have access to programmable test equipment. You can program the instrument configurations specified for each test over the remote interface. You can then enter readback verification data into a test program and compare the results to the appropriate test limit values.

You can also enter calibration constants from the remote interface. Remote operation is similar to the local front-panel procedure. You can use a computer to perform the adjustment by first selecting the required setup. The calibration value is sent to the function generator and then the calibration is initiated over the remote interface. The function generator must be unsecured prior to initiating the calibration procedure. For further detailing on programming the function generator, see chapters 3 and 4 in the *Agilent 33120A User's Guide*.

Recommended Test Equipment

The test equipment recommended for the performance verification and adjustment procedures is listed below. If the exact instrument is not available, use the accuracy requirements shown to select substitute calibration standards.

Instrument	Requirements	Recommended Model	Use*
50 Ω feedthrough load	50 Ω ± 0.1 Ω		Q,P,O,T
6 1/2 digit Digital Multimeter (DMM)	20 Vdc ± 0.01% Integrating ACrms 10 Vacrms ± 0.1%	Agilent 34401A	Q,P,T
Thermal Voltage Converter (50 Ω termination type) or Power Meter or Wideband ACrms Meter	1kHz to 15 MHz 100 kHz to 15 MHz 1 VAC rms ± 0.5% 1 kHz to 20 MHz	3 Volt Agilent E4418A with Agilent 8482A and 20 dB attenuator —	Q,P
Frequency Meter	1 ppm accuracy	Agilent 53131A	Q,P,T
Oscilloscope	100 MHz	Agilent 54624A	T
Spectrum Analyzer	Response to 90 MHz	Agilent 8560EC	O

* Q = Quick Verification
P = Performance Verification Tests
O= Optional Verification Tests
T = Troubleshooting

Test Considerations

To ensure proper instrument operation, verify that you have selected the correct power line voltage prior to attempting any test procedure in this chapter. See page 22 in chapter 2 for more information.

For optimum performance, all test procedures should comply with the following recommendations:

- Verify the function generator is set to the default power on state (power on default). A procedure is given on page 41.
- Make sure that the calibration ambient temperature is stable and between 18 °C and 28 °C.
- Make sure ambient relative humidity is less than 80%.
- Allow a 1-hour warm-up period before verification or adjustment.
- Use only RG-58 or equivalent 50Ω cable.
- Keep cables as short as possible, consistent with the impedance requirements.

Performance Verification Tests

The performance verification tests use the function generator's specifications listed in chapter 1, "Specifications," starting on page 13.

You can perform four different levels of performance verification tests:

- **Self-Test** A series of internal verification tests that give a high confidence that the function generator is operational.

Q
- **Quick Verification** A combination of the internal self-tests and selected verification tests.

P
- **Performance Verification Tests** An extensive set of tests that are recommended as an acceptance test when you first receive the function generator or after performing adjustments.

O
- **Optional Verification Tests** Tests *not* performed with every calibration. These tests can can be used to verify additional instrument specifications following repairs to specific circuits.

Self-Test

A brief power-on self-test occurs automatically whenever you turn on the function generator. This limited test assures that the function generator is capable of operation.

To perform a complete self-test hold down the Shift key as you press the Power switch to turn on the function generator; *hold down the key for more than 5 seconds* (a complete description of these tests can be found in chapter 6). The function generator will automatically perform the complete self-test procedure when you release the key. The self-test will complete in approximately 5 seconds.

You can perform many tests individually (or all tests at once) using the TEST command in the SYS MENU. You can also perform a self-test from the remote interface (*see chapter 3 in the Agilent 33120A User's Guide*).

- If the self-test is successful, "PASS" is displayed on the front panel.
- If the self-test fails, "FAIL" is displayed and the **ERROR** annunciator turns on. If repair is required, see chapter 6, "Service," for further details.
- If all tests pass, you have a high confidence (90%) that the function generator is operational.

Quick Performance Check

The quick performance check is a combination of internal self-test and an abbreviated performance test (specified by the letter **Q** in the performance verification tests). This test provides a simple method to achieve high confidence in the function generator's ability to functionally operate and meet specifications. These tests represent the absolute minimum set of performance checks recommended following any service activity. Auditing the function generator's performance for the quick check points (designated by a **Q**) verifies performance for "normal" accuracy drift mechanisms. *This test does not check for abnormal component failures.*

To perform the quick performance check, do the following:

- Set the function generator to the default power on state (power on default). A procedure is given on page 41.
- Perform a complete self-test. A procedure is given on page 21.
- Perform only the performance verification tests indicated with the letter **Q**.

If the function generator fails the quick performance check, adjustment or repair is required.

Performance Verification Tests

The performance verification tests are recommended as acceptance tests when you first receive the function generator. The acceptance test results should be compared against the 1 year test limits. After acceptance, you should repeat the performance verification tests at every calibration interval.

If the function generator fails performance verification, adjustment or repair is required.

Frequency Verification

This test verifies the frequency accuracy of the two sources in the function generator. All output frequencies are derived from a single generated frequency, and only one frequency point is checked. The second test verifies the burst rate frequency.

Set the function generator for each output indicated in the table below. Use a frequency meter to measure the output frequency. Compare the measured results to the test limits shown in the table. This is a 50Ω output termination test.

	Agilent 33120A						Measurement	
	Function	OUT [1] TERM	Ampl	Freq	BURST RATE	BURST CNT	Nominal	Error
Q	Sine wave	50 Ω	3.5 Vrms	1.00 kHz	—	—	1.00 kHz	± **0.02 Hz**
Q	Square wave	50 Ω	3.5 Vrms	1.00 kHz	500 Hz	1 CYC	500 Hz	± **5 Hz**

Function Gain and Linearity Verification

This test verifies the output amplitude accuracy specification for sine wave, triangle wave, ramp, and square wave outputs.

Set the function generator for each output indicated in the table below. Use a DMM to measure the function generator ACrms output voltage. Compare the measured results to the test limits shown in the table. This is a HIGH Z output termination test.

	Agilent 33120A				Measurement	
	Function	OUT TERM [1]	Ampl	Freq	Nominal	Error
Q	Sine wave	HIGH Z	7.0 Vrms	1.0 kHz	7.0 Vrms	± **0.07 Vrms**
	Sine wave	HIGH Z	5.7 Vrms	1.0 kHz	5.7 Vrms	± **0.057 Vrms**
	Triangle wave	HIGH Z	5.7 Vrms	100 Hz	5.7 Vrms	± **0.057 Vrms**
	Ramp wave	HIGH Z	5.7 Vrms	100 Hz	5.7 Vrms	± **0.057 Vrms**
Q	Square wave	HIGH Z	10.0 Vrms	100 Hz	10.0 Vrms	± **0.1 Vrms**
	Square wave	HIGH Z	8.0 Vrms	100 Hz	8.0 Vrms	± **0.08 Vrms**

[1] *Output termination set using front panel controls. HIGH Z assumes no load on output. 50Ω assumes a 50Ω ± 0.1Ω load on output.*

DC Function Offset Verification

This test verifies the DC offset and DC output specifications.

Set the function generator for each output indicated in the table below. Use a DMM to measure the function generator dcV output. Compare the measured results to the test limits shown in the table. This is a HIGH Z output termination test.

	Agilent 33120A			Measurement	
	Function	OUT TERM [1]	Ampl	Nominal	Error
Q	DC Volts	HIGH Z	10.0 Vdc	10.0 Vdc	± **0.20 Vdc**
	DC Volts	HIGH Z	-10.0 Vdc	-10.0 Vdc	± **0.20 Vdc**

AC Amplitude Verification

This procedure is used to check the output amplitude calibration of the function generator. Verification checks are performed to check the accuracy of the pre-attenuator and post attenuator. *Make sure you have read "Test Considerations" on page 53.*

Set the function generator for each output indicated in the table on the next page. Use a DMM to measure the ACrms output voltage of the function generator. Compare the measured results to the test limits shown in the table. This is a HIGH Z output termination test.

[1] *Output termination set using front panel controls. HIGH Z assumes no load on output. 50Ω assumes a 50Ω ±0.1Ω load on output.*

	Agilent 33120A				Measurement	
	Function	OUT TERM [1]	Ampl	Freq	Nominal	Error
Q	Sine wave	HIGH Z	7.0 Vrms	1.00 kHz	7.0 Vrms	± **0.070 Vrms**
	Sine wave	HIGH Z	5.7 Vrms	1.00 kHz	5.7 Vrms	± **0.057 Vrms**
	Sine wave	HIGH Z	5.5 Vrms	1.00 kHz	5.5 Vrms	± **0.055 Vrms**
	Sine wave	HIGH Z	4.4 Vrms	1.00 kHz	4.4 Vrms	± **0.044 Vrms**
	Sine wave	HIGH Z	3.5 Vrms	1.00 kHz	3.5 Vrms	± **0.035 Vrms**
	Sine wave	HIGH Z	2.8 Vrms	1.00 kHz	2.8 Vrms	± **0.028 Vrms**
	Sine wave	HIGH Z	2.2 Vrms	1.00 kHz	2.2 Vrms	± **0.022 Vrms**
	Sine wave	HIGH Z	1.7 Vrms	1.00 kHz	1.7 Vrms	± **0.017 Vrms**
	Sine wave	HIGH Z	1.4 Vrms	1.00 kHz	1.4Vrms	± **0.014 Vrms**
	Sine wave	HIGH Z	1.1 Vrms	1.00 kHz	1.1 Vrms	± **0.011 Vrms**
Q	Sine wave	HIGH Z	0.88 Vrms	1.00 kHz	0.88 Vrms	± **0.0088 Vrms**
	Sine wave	HIGH Z	0.70 Vrms	1.00 kHz	0.70 Vrms	± **0.0070 Vrms**
	Sine wave	HIGH Z	0.55 Vrms	1.00 kHz	0.55 Vrms	± **0.0055 Vrms**
	Sine wave	HIGH Z	0.44 Vrms	1.00 kHz	0.44 Vrms	± **0.0044 Vrms**
	Sine wave	HIGH Z	0.35 Vrms	1.00 kHz	0.35 Vrms	± **0.0035 Vrms**
	Sine wave	HIGH Z	0.28 Vrms	1.00 kHz	0.28 Vrms	± **0.0028 Vrms**
	Sine wave	HIGH Z	0.22 Vrms	1.00 kHz	0.22 Vrms	± **0.0022 Vrms**
	Sine wave	HIGH Z	0.17 Vrms	1.00 kHz	0.17 Vrms	± **0.0017 Vrms**
	Sine wave	HIGH Z	0.14 Vrms	1.00 kHz	0.14 Vrms	± **0.0014 Vrms**
	Sine wave	HIGH Z	0.11 Vrms	1.00 kHz	0.11 Vrms	± **0.0011 Vrms**
Q	Sine wave	HIGH Z	0.088 Vrms	1.00 kHz	0.088Vrms	± **0.00088 Vrms**
	Sine wave	HIGH Z	0.070 Vrms	1.00 kHz	0.070 Vrms	± **0.00070 Vrms**
	Sine wave	HIGH Z	0.055 Vrms	1.00 kHz	0.055 Vrms	± **0.00055 Vrms**
	Sine wave	HIGH Z	0.044 Vrms	1.00 kHz	0.044 Vrms	± **0.00044 Vrms**
Q	Sine wave	HIGH Z	0.036 Vrms	1.00 kHz	0.036 Vrms	± **0.00036 Vrms**

[1] *Output termination set using front panel controls. HIGH Z assumes no load on output. 50Ω assumes a 50Ω ± 0.1Ω load on output.*

Install the 50Ω feedthrough load between the DMM and the function generator output. Set the function generator for each output indicated in the table on the next page. Use a DMM to measure the ACrms output voltage of the function generator. Compare the measured results to the test limits shown in the table. This is a 50Ω output termination test.

	Agilent 33120A				Measurement	
	Function	OUT TERM [1]	Ampl	Freq	Nominal	Error
Q	Sine wave	50 Ω	3.5 Vrms	1.0000 kHz	3.5 Vrms	± **0.035 Vrms**
	Sine wave	50 Ω	2.8 Vrms	1.0000 kHz	2.8 Vrms	± **0.028 Vrms**
	Sine wave	50 Ω	2.2 Vrms	1.0000 kHz	2.2 Vrms	± **0.022 Vrms**
	Sine wave	50 Ω	1.7 Vrms	1.0000 kHz	1.7 Vrms	± **0.017 Vrms**
	Sine wave	50 Ω	1.4Vrms	1.0000 kHz	1.4Vrms	± **0.014 Vrms**
	Sine wave	50 Ω	1.1 Vrms	1.0000 kHz	1.1 Vrms	± **0.011 Vrms**
Q	Sine wave	50 Ω	0.88 Vrms	1.0000 kHz	0.88 Vrms	± **0.0088 Vrms**
	Sine wave	50 Ω	0.70 Vrms	1.0000 kHz	0.70 Vrms	± **0.0070 Vrms**
	Sine wave	50 Ω	0.55 Vrms	1.0000 kHz	0.55 Vrms	± **0.0055 Vrms**
	Sine wave	50 Ω	0.44 Vrms	1.0000 kHz	0.44 Vrms	± **0.0044 Vrms**
	Sine wave	50 Ω	0.35 Vrms	1.0000 kHz	0.35 Vrms	± **0.0035 Vrms**
	Sine wave	50 Ω	0.28 Vrms	1.0000 kHz	0.28 Vrms	± **0.0028 Vrms**
	Sine wave	50 Ω	0.22 Vrms	1.0000 kHz	0.22 Vrms	± **0.0022 Vrms**
	Sine wave	50 Ω	0.17 Vrms	1.0000 kHz	0.17 Vrms	± **0.0017 Vrms**
	Sine wave	50 Ω	0.14 Vrms	1.0000 kHz	0.14 Vrms	± **0.0014 Vrms**
	Sine wave	50 Ω	0.11 Vrms	1.0000 kHz	0.11 Vrms	± **0.0011 Vrms**
	Sine wave	50 Ω	0.088Vrms	1.0000 kHz	0.088Vrms	± **0.00088 Vrms**
	Sine wave	50 Ω	0.070 Vrms	1.0000 kHz	0.070 Vrms	± **0.00070 Vrms**
	Sine wave	50 Ω	0.055 Vrms	1.0000 kHz	0.055 Vrms	± **0.00055 Vrms**
	Sine wave	50 Ω	0.044 Vrms	1.0000 kHz	0.044 Vrms	± **0.00044 Vrms**
Q	Sine wave	50 Ω	0.035 Vrms	1.0000 kHz	0.035 Vrms	± **0.00035 Vrms**
	Sine wave	50 Ω	0.028 Vrms	1.0000 kHz	0.028 Vrms	± **0.00028 Vrms**
	Sine wave	50 Ω	0.022 Vrms	1.0000 kHz	0.022 Vrms	± **0.00022 Vrms**
	Sine wave	50 Ω	0.018 Vrms	1.0000 kHz	0.018 Vrms	± **0.00018 Vrms**

[1] *Output termination set using front panel controls. HIGH Z assumes no load on output. 50Ω assumes a 50Ω ± 0.1Ω load on output.*

Amplitude Flatness Verification

This test verifies the output amplitude flatness specification at selected frequencies. If you use a TVC (recommended) or a wide band ACrms voltmeter (with a 50Ω feed through load), perform this procedure as described. If you are using a measurement device that requires a transfer measurement (for example, a power meter), make the transfer in the reference measurement at 100 kHz.

Set the function generator to the first output indicated in the table below and make a reference measurement. Select each function generator output in the table below and adjust the function generator output amplitude until the measured output is at the reference measurement. Compare the amplitude level set on the front panel to the test limits shown in the table. This test is a 50Ω output termination test.

	Agilent 33120A				Measurement	
	Function	OUT [1] TERM	Ampl	Freq	Nominal	Error
Q	Sine wave	50 Ω	3.0 Vrms	1.00 kHz	<reference>	
	Sine wave	50 Ω	3.0 Vrms	100.00 kHz	<reference>	± **0.03 Vrms**
	Sine wave	50 Ω	3.0 Vrms	500.00 kHz	<reference>	± **0.045 Vrms**
Q	Sine wave	50 Ω	3.0 Vrms	1.00 MHz	<reference>	± **0.045 Vrms**
	Sine wave	50 Ω	3.0 Vrms	3.00 MHz	<reference>	± **0.06 Vrms**
	Sine wave	50 Ω	3.0 Vrms	5.00 MHz	<reference>	± **0.06 Vrms**
	Sine wave	50 Ω	3.0 Vrms	7.00 MHz	<reference>	± **0.06 Vrms**
	Sine wave	50 Ω	3.0 Vrms	9.00 MHz	<reference>	± **0.06 Vrms**
	Sine wave	50 Ω	3.0 Vrms	11.00 MHz	<reference>	± **0.06 Vrms**
	Sine wave	50 Ω	3.0 Vrms	13.00 MHz	<reference>	± **0.06 Vrms**
Q	Sine wave	50 Ω	3.0 Vrms	15.00 MHz	<reference>	± **0.06 Vrms**

[1] *Output termination set using front panel controls. HIGH Z assumes no load on output. 50Ω assumes a 50Ω ±0.1Ω load on output.*

AM Modulation Depth Verification

This test verifies the modulation depth specification.

Select each function generator output in the table below. Use a DMM to measure the function generator ACrms output voltage. Compare the measured results to the test limits shown in the table. This is a HIGH Z output termination test.

	Agilent 33120A							Measurement	
					AM Modulation				
	Function	OUT [1] TERM	Ampl	Freq	Shape	Freq	Depth	Nominal	Error
Q	Sine wave	HIGH Z	1.0 Vrms	1.00 kHz	Sinewave	100 Hz	0%	0.50 Vrms	± **0.005 Vrms**
	Sine wave	HIGH Z	1.0 Vrms	1.00 kHz	Sinewave	100 Hz	100%	0.61 Vrms	± **0.0061 Vrms**

[1] *Output termination set using front panel controls. HIGH Z assumes no load on output. 50Ω assumes a 50Ω ± 0.1Ω load on output.*

Optional Performance Verification Tests

These tests are *not* intended to be performed with every calibration. They are provided as an aid for verifying additional instrument specifications.

Square Wave Duty Cycle Verification

This test verifies the duty cycle specification of the squarewave output.

Select each function generator output in the table below. Use an *integrating* DMM to measure the Vdc output of the function generator. Compare the measured results to the test limits shown in the table. This is a HIGH Z output termination test.

Agilent 33120A					Measurement	
Function	OUT [1] TERM	Ampl	Freq	Duty Cycle	Nominal	Error
Square wave	HIGH Z	1.0 Vrms	300.00 Hz	50%	0.00 Vdc	± **0.020 Vdc**
Square wave	HIGH Z	1.0 Vrms	300.00 Hz	25%	- 0.50 Vdc	± **0.020 Vdc**
Square wave	HIGH Z	1.0 Vrms	300.00 Hz	75%	+ 0.50 Vdc	± **0.020 Vdc**

The DMM used for this test must be an integrating multimeter. If the first step does not measure 0 Vdc, use an oscilloscope for this test.

Do not use an auto-ranging function on the DMM for this test. Fix the DMM measurement range at 10 Vdc.

[1] *Output termination set using front panel controls. HIGH Z assumes no load on output. 50Ω assumes a 50Ω ± 0.1Ω load on output.*

Distortion Verification

This test checks the Harmonic Distortion at selected frequencies and harmonics. This test requires the use of a spectrum analyzer with dynamic range, frequency range, and resolution bandwidth adequate for the measurement.

Select each function generator output in the table below. Use a spectrum analyzer connected to the function generator output. Set the fundamental frequency reference to 0 dB and measure the 2nd through 5th harmonic frequencies relative to this reference. This test is a 50Ω output termination test.

Agilent 33120A				Measurement					
					harmonic				
Function	OUT [1] TERM	Ampl	Freq	Fundamental	2nd	3rd	4th	5th	Value below reference
Sine wave	50 Ω	1.1 Vrms	20.00 kHz	reference	40 kHz	60 kHz	80 kHz	100 kHz	< 70 dB
Sine wave	50 Ω	1.1 Vrms	100.00 kHz	reference	200 kHz	300 kHz	400 kHz	500 kHz	< 60 dB
Sine wave	50 Ω	1.1 Vrms	1.00 MHz	reference	2 MHz	3 MHz	4 MHz	5 MHz	< 45 dB
Sine wave	50 Ω	1.1 Vrms	15.00 MHz	reference	30 MHz	45 MHz	60 MHz	75 MHz	< 35 dB

[1] *Output termination set using front panel controls. HIGH Z assumes no load on output. 50Ω assumes a 50Ω ± 0.1Ω load on output.*

Calibration Security Code

This feature allows you to enter a security code (electronic key) to prevent accidental or unauthorized calibrations of the function generator. When you first receive your function generator, it is secured. Before you can adjust calibration constants you *must* unsecure the function generator by entering the correct security code. A procedure to unsecure the function generator is given on page 47.

- The security code is set to "HP033120" when the function generator is shipped from the factory. The security code is stored in *non-volatile* memory, and *does not* change when power has been off or after a remote interface reset.

- To secure the function generator from the remote interface, the security code may contain up to 12 alphanumeric characters as shown below. The first character *must* be a letter, but the remaining characters can be letters or numbers. You do not have to use all 12 characters but the first character must always be a letter.

  A _ _ _ _ _ _ _ _ _ _ _ _ *(12 characters)*

- To secure the function generator from the remote interface but allow it to be unsecured from the front panel, use the eight-character format shown below. The first two characters must be "HP" and the remaining characters must be numbers. *Only the last six characters are recognized from the front panel, but all eight characters are required*. (To unsecure the function generator from the front panel, omit the "HP" and enter the remaining numbers.)

  H P _ _ _ _ _ _ *(8 characters)*

- *If you forget your security code*, you can disable the security feature by adding a jumper inside the function generator, and then entering a new code. *See the procedure on the following page.*

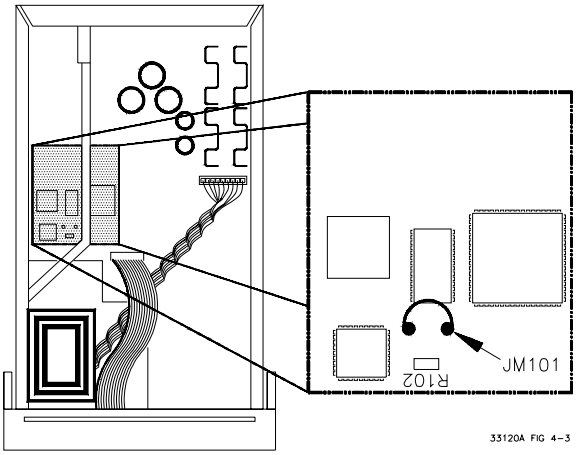
To Unsecure the Function Generator Without the Security Code

To unsecure the function generator without the correct security code, follow the steps below. A procedure to unsecure the function generator is given on page 47. Also see "Electrostatic Discharge (ESD) Precautions" in chapter 6 before beginning this procedure.

WARNING

SHOCK HAZARD. Only service-trained personnel who are aware of the hazards involved should remove the instrument covers. The procedures in this section require that you connect the power cord to the instrument with the covers removed. To avoid electrical shock and personal injury, be careful not to touch the power-line connections.

1. Disconnect the power cord and all input connections (front and rear terminals).
2. Remove the instrument cover. Refer to the disassembly drawing on page 130.
3. Connect the power cord and turn on the function generator.
4. Apply a short between the two exposed metal pads on JM101 (located near U106 and U205) as shown in the figure below.



5. While maintaining the short, enter any unsecure code. The function generator is now unsecured.
6. Remove the short at JM101.
7. Turn off and reassemble the function generator.
8. The function generator is now unsecured and you can enter a new security code. Be sure you take note of the new security code.

Calibration Count

The calibration count feature provides an independent "serialization" of your calibrations. You can determine the number of times that your function generator has been calibrated. By monitoring the calibration count, you can determine whether an unauthorized calibration has been performed. Since the value increments by one for each calibration, a complete calibration increases the value by approximately 85 counts.

- The calibration count is stored in *non-volatile* memory and *does not* change when power has been off or after a remote interface reset. Your function generator was calibrated before it left the factory. When you receive your function generator, read the calibration count to determine its value.

- The calibration count increments up to a maximum of 32,767 after which it wraps around to 0. There is no way provided to program or reset the calibration count. It is an independent electronic calibration "serialization" value.

Calibration Message

You can use the calibration message feature to record calibration information about your function generator. For example, you can store such information as the last calibration date, the next calibration due date, the function generator's serial number, or even the name and phone number of the person to contact for a new calibration.

You can record information in the calibration message only from the remote interface. You can read the message from either the front-panel menu or the remote interface.

- The calibration message may contain up to 40 characters. The function generator can display up to 11 characters of the message on the front panel; any additional characters are truncated.

- The calibration message is stored in *non-volatile* memory, and *does not* change when power has been off or after a remote interface reset.

General Calibration/Adjustment Procedure

The adjustment procedures described in chapter 4 use the CAL MENU to generate and set internal calibration constants. The general menu procedure is the same for all calibration setups. *The following example demonstrates making the Frequency and Burst Rate adjustments.*

Shift

1 Turn on the menu.

Menu On/Off

```
A: MOD MENU
```

<

2 Move across to the CAL MENU choice on this level. ◎[1]

```
F: CAL MENU
```

∨

3 Move down a level to the UNSECURED command.

```
1: UNSECURED
```

If the display shows SECURED, you will have to unsecure the function generator to perform the calibration procedures. A procedure is given on page 47.

>

4 Move across to the CALIBRATE choice. ◎[1]

```
2: CALIBRATE
```

∨

5 Move down one level.

The display indicates the calibration setup number. You can change this number to perform individual specification adjustments.

```
SETUP 00
```

Enter

6 Begin the Frequency and Burst Rate adjustment procedure.

< > **7 Move the flashing cursor over the digit to be edited.** [1]

^ v **8 Change the value in the display to match the measured frequency.**

```
1.000,0040KHz
```

Enter **9 Calculate and save the new value.**

```
CALIBRATING
```

10 Perform the next adjustment procedure.

The setup number and function generator output is automatically set for the next adjustment procedure.

```
SETUP ^01
```

You will press ENTER twice for each calibration step, once to select the setup (as described in step 6) and once to enter the adjustment (as described in step 9).

[1] *You can also use the knob to scroll left or right through the choices on each level of the menu*

Aborting a Calibration in Progress

Sometimes it may be necessary to abort a calibration after the procedure has already been initiated. You can abort a calibration at any time by pressing any front-panel key (except Shift-Cancel). When performing a calibration from the remote interface, you can abort a calibration by issuing a remote interface device clear message or by pressing the front-panel LOCAL key.

Frequency and Burst Rate Adjustment

The function generator stores two calibration constants related to frequency and burst rate output. The constants are calculated from the adjustment value entered and are stored at the completion of each setup.

1 Use a frequency meter to measure the function generator output frequency for each setup in the following table. These adjustments use a 50Ω output termination.

	Nominal Output		
SETUP	FREQUENCY	AMPLITUDE	
00 *	1.00 kHz	10 Vpp	Adjustment for main frequency generator, sine wave output
01	500 Hz	10 Vpp	Adjustment for burst rate timing, pulse output.

* A new calibration (SETUP 86 – Rev 4.0) has been added as an alternative to SETUP 00. The new calibration outputs a 10 MHz sine wave, rather than the 1 kHz signal used for SETUP 00. The new calibration reduces slew rate dependent errors in the frequency measurement and is especially important when calibrating the Phase-Lock Assembly (Option 001). Note that either setup is sufficient to calibrate the carrier frequency and you don't need to perform both.

2 Use the CALIBRATE menu to adjust the displayed frequency at each setup to match the measured frequency and enter the value.

3 Perform the Frequency Verification procedures on page 56.

Function Gain and Linearity Adjustment

The function generator stores six calibration constants related to function gain and linearity. The constants are calculated from the adjustment value entered. *If the calibration procedure is aborted before all setup steps have been completed, no calibration constants are stored.*

1 Use a DMM to measure the function generator ACrms output voltage for each setup in the following table. These adjustments use a HIGH Z output termination.

	Nominal Output		
SETUP	FREQUENCY	AMPLITUDE	
02	1 kHz	7.07 V rms	Adjustment for sine wave gain.
03	1 kHz	5.6 V rms	Adjustment for amplitude linearity.
04	100 Hz	5.6 V rms	Adjustment for triangle wave gain.
05	100 Hz	5.6 V rms	Adjustment for ramp gain.
06	100 Hz	10.0 V rms	Adjustment for square wave gain.
07	100 Hz	1.1 Vrms	Adjustment for square wave linearity.

2 Use the CALIBRATE menu to adjust the displayed amplitude at each setup to match the measured amplitude and enter the value.

3 Perform the Function Gain and Linearity Verification procedures on page 56.

AC Amplitude Adjustment (High-Z)

The function generator stores twenty-two calibration constants related to HIGH Z output, and sixteen calibration constants related to 50Ω output. The constants are calculated from the adjustment value entered. The calibration constants are stored following completion of setup 22 (HIGH Z output) and the calibration procedure may be aborted after that point. No calibration constants are stored if the procedures are aborted at any other setup.

1 Use a DMM to measure the function generator ACrms output voltage for each setup in the following table. These adjustments use a HIGH Z output termination.

	Nominal Output		
SETUP	FREQUENCY	AMPLITUDE	Adjustment for:
8	1 kHz	5.5 V rms	2 dB Output Attenuator
9	1 kHz	4.4 V rms	4 dB Output Attenuator
10	1 kHz	3.5 V rms	6 dB Output Attenuator
11	1 kHz	2.8 V rms	8 dB Output Attenuator
12	1 kHz	2.2 V rms	10 dB Output Attenuator
13	1 kHz	1.7 V rms	12 dB Output Attenuator
14	1 kHz	1.4 V rms	14 dB Output Attenuator
15	1 kHz	1.1 V rms	16 dB Output Attenuator
16	1 kHz	0.88 V rms	18 dB Output Attenuator
17	1 kHz	0.70 V rms	20 dB Output Attenuator
18	1 kHz	0.55 V rms	22 dB Output Attenuator
19	1 kHz	0.44 V rms	24 dB Output Attenuator
20	1 kHz	0.35 V rms	26 dB Output Attenuator
21	1 kHz	0.28 V rms	28 dB Output Attenuator
22	1 kHz	0.22 V rms	30 dB Output Attenuator
23	1 kHz	5.5 V rms	2 dB Pre-attenuator
24	1 kHz	4.4 V rms	4 dB Pre-attenuator
25	1 kHz	3.5 V rms	6 dB Pre-attenuator
26	1 kHz	2.8 V rms	8 dB Pre-attenuator
27	1 kHz	2.2V rms	10 dB Pre-attenuator
28	1 kHz	1.7 V rms	12 dB Pre-attenuator
29	1 kHz	1.4 Vrms	14 dB Pre-attenuator

2 Use the CALIBRATE menu to adjust the displayed amplitude at each setup to match the measured amplitude and enter the value.

3 Perform the AC Amplitude Verification procedures on page 57.

Modulation Adjustment

The function generator stores three calibration constants related to amplitude modulation depth. The constants are calculated from the adjustment value entered. *If the calibration procedure is aborted before all setup steps have been completed, no calibration constants are stored.*

1 Use a DMM to measure the function generator ACrms output voltage for each setup in the following table. These adjustments use a HIGH Z output termination.

	Nominal Output		
SETUP	FREQUENCY	AMPLITUDE	Adjustment for:
30	1 kHz	3.5 Vrms	0% modulation depth.
31	1 kHz	0.707 Vrms	50% modulation depth.
32	1 kHz	6.36 Vrms	100% modulation depth.

2 Use the CALIBRATE menu to adjust the displayed amplitude at each setup to match the measured amplitude and enter the value.

3 Perform the AM Modulation Depth Verification procedures on page 61.

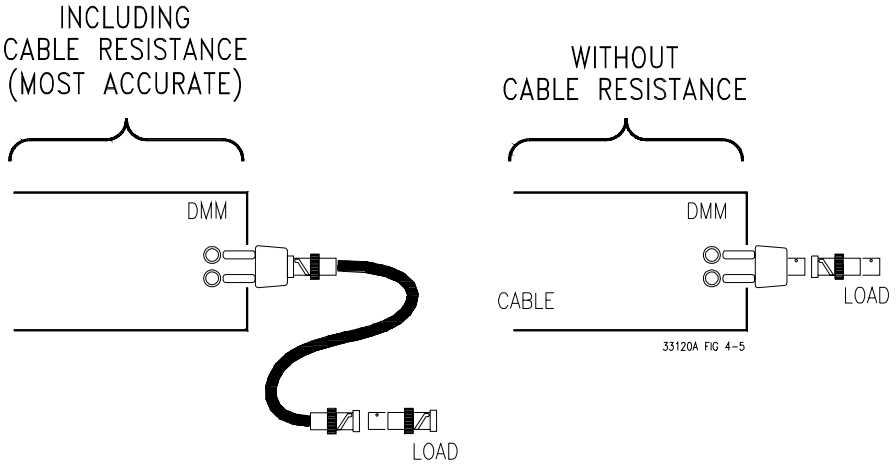
NEW CALIBRATION: *A new calibration (SETUP 85 – Rev 4.0) has been added to eliminate a small residual error in the AM amplitude system which could potentially cause a failure of the AM amplitude verification. The new calibration operates just like the other AM calibrations (SETUP 30, 31, 32) in that the external measurement is AC Vrms with no load. The new calibration is not allowed until the other AM gain calibrations (SETUP 30, 31, 32) are performed.*

The new algorithm is designed such that the calibration should not be required again once the function generator has been calibrated at the factory. However, if you change any critical analog components which determine amplitude in AM modulation, you should perform the calibration again.

AC Amplitude Adjustment (50Ω)

1 The function generator stores 16 calibration constants related to 50Ω output. The constants are calculated from the adjustment value entered. The calibration constants are stored following completion of setup 49 and the calibration procedure may be aborted after that point. No calibration constants are stored if the procedures are aborted at any other setup.

2 Use the DMM to measure the resistance of a 50Ω feedthrough load. Record the measurement for step 3. You can measure the load and cable resistance (recommended procedure) or just the load as shown below.

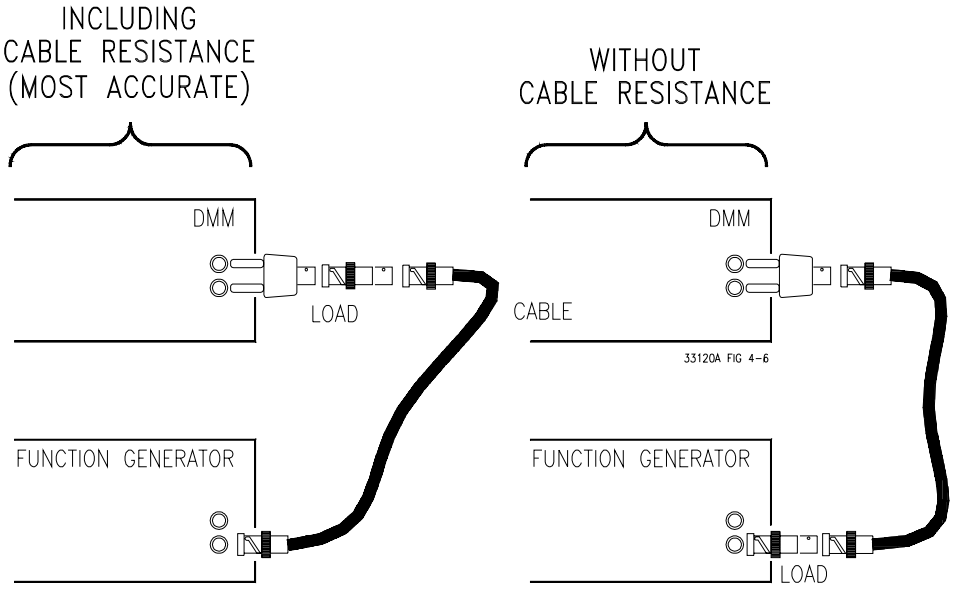


3 Enter the following setup and use the calibrate menu to enter the measured value of the 50Ω feedthrough load (and cable). This number will be used to calculate the 50Ω output amplitude calibration constants.

	Nominal Input	
SETUP	LOAD Z	
33	50 Ω	Enter measured value of load.

Once the value of the 50Ω load and cable are entered, use the SAME load and cable for all 50Ω tests.

4 Use the DMM to measure the function generator ACrms output voltage for each setup in the table on the next page. These adjustments use the 50Ω load and cable measured in step 2 and connected as shown below.



	Nominal Output		
SETUP	FREQUENCY	AMPLITUDE	Adjustment for:
34	1 kHz	3.5 Vrms	0 dB Output Attenuator
35	1 kHz	2.8 Vrms	2 dB Output Attenuator
36	1 kHz	2.23 Vrms	4 dB Output Attenuator
37	1 kHz	1.77 Vrms	6 dB Output Attenuator
38	1 kHz	1.41 Vrms	8 dB Output Attenuator
39	1 kHz	1.12 Vrms	10 dB Output Attenuator
40	1 kHz	.887 Vrms	12 dB Output Attenuator
41	1 kHz	.704 Vrms	14 dB Output Attenuator
42	1 kHz	.559 Vrms	16 dB Output Attenuator
43	1 kHz	.442 Vrms	18 dB Output Attenuator
44	1 kHz	.350 Vrms	20 dB Output Attenuator
44	1 kHz	.281 Vrms	22 dB Output Attenuator
46	1 kHz	.223 Vrms	24 dB Output Attenuator
47	1 kHz	.177 Vrms	26 dB Output Attenuator
48	1 kHz	.141 Vrms	28 dB Output Attenuator
49	1 kHz	.112 Vrms	30 dB Output Attenuator

5 Use the CALIBRATE menu to adjust the displayed amplitude at each setup to match the measured amplitude and enter the value.

6 Perform the AC Amplitude Verification procedures beginning on page 57.

DC Output Adjustment

The function generator stores nine calibration constants related to DC volts output. The constants are calculated from the adjustment value entered. The calibration constants are stored following completion of setup 59. *No calibration constants are stored if the procedures are aborted at any other setup.*

1 Use a DMM to measure the function generator dcV output voltage for each setup in the following table. These adjustments use a HIGH Z output termination.

	Nominal Output	
SETUP	DC Volts	Adjustment for:
50	- 8.0 Vdc	Negative offset gain
51	8.0 Vdc	Positive offset gain
52	0.0 Vdc	AM offset
53	0.0 Vdc	2 dB Pre-attenuator offset.
54	0.0 Vdc	4 dB Pre-attenuator offset.
55	0.0 Vdc	6 dB Pre-attenuator offset.
56	0.0 Vdc	8 dB Pre-attenuator offset.
57	0.0 Vdc	10 dB Pre-attenuator offset.
58	0.0 Vdc	12 dB Pre-attenuator offset.
59	0.0 Vdc	14 dB Pre-attenuator offset.

2 Use the CALIBRATE menu to adjust the displayed output voltage at each setup to match the measured voltage and enter the value.

3 Perform the DC Function Offset Verification procedures on page 57.

Duty Cycle Adjustment

The function generator stores two calibration constants related to squarewave offset and two calibration constants related to squarewave duty cycle. The constants are calculated from the adjustment value entered. The calibration constants are stored following completion of setup 63. *No calibration constants are stored if the procedures are aborted at any other setup.*

1 Use a DMM to measure the function generator dcV output voltage for each setup in the following table. These adjustments use a HIGH Z output termination.

> *For this test, the DMM must be set to a fixed range capable of measuring from +10 V to -10 V. Do not use an auto-ranging function for this test.*

	Nominal Output		
SETUP	FREQUENCY	AMPLITUDE	
60	—	10.0 Vdc	Positive squarewave offset.
61	—	-10.0 Vdc	Negative squarewave offset.
62	300 Hz	0.0 Vdc	50% duty cycle squarewave.
63	300 Hz	5.0 Vdc	75% duty cycle squarewave

2 Use the CALIBRATE menu to adjust the displayed output voltage at each setup to match the measured voltage and enter the value.

3 Perform the Squarewave Duty Cycle Verification procedures on page 62.

AC Amplitude Flatness Adjustment

The function generator stores eleven calibration constants related to AC Amplitude Flatness from 1 kHz to 15 MHz. The constants are calculated from the adjustment value entered and one of two calculation constants related to the type of measurement device you are using. The calibration constants are stored following completion of setup 82. *No calibration constants are stored if the procedures are aborted at any other setup.*

This procedure can be performed with one of three types of measurement device; a broadband ACrms voltmeter, a power meter, or a thermal voltage converter. The procedure differs slightly depending upon the type of measurement device used. These adjustments us a 50Ω output termination.

1 Use a DMM to measure the ACrms output voltage of the function generator and enter the measurement value for the setup in the table below.

	Nominal Output		
SETUP	FREQUENCY	AMPLITUDE	Reference for:
64	1 kHz	3.0 V rms	1 kHz flatness DAC gain

2 **a.** If you are using a broadband ACrms voltmeter, proceed to step 3.

b. If you are using a power meter capable of measurements at 1 kHz, use the power meter to measure the function generator output and enter the value for the setup in the table below. (If your power meter does not measure to 1 kHz, see the transfer measurement procedure below.)

	Nominal Output		
SETUP	FREQUENCY	AMPLITUDE	Reference for:
83	1 kHz	3.0 V rms	V rms, dBm

Transfer Measurement Procedure
If you are using a power meter not capable of measurement to 1 kHz, you can perform the transfer measurement at a different frequency. For example, the Agilent E4418A Power Meter with the Agilent 8482A probe and 20 dB attenuator are specified to a low frequency of 100 kHz. To use this measurement device, perform step 1, then use setup 65 to obtain a 100 kHz output. Measure the output with the power meter and record the measured value. Perform setup 83 and enter the recorded value (not a new measurement). Then, perform step 3 (you will use setup 65 twice). *This procedure assumes the output of the function generator is flat from 1 kHz to 100 kHz.*

c. If you are using a Thermal Voltage Converter (TVC), use the TVC to measure the function generator output and enter the measurement for the setup in the table below (TVC values entered are in mVdc).

	Nominal Output		
SETUP	FREQUENCY	AMPLITUDE	Reference for:
84	1 kHz	3.0 V rms	Thermal Voltage Converter

3 For each setup in the table below, use the CALIBRATE command to change the displayed amplitude to match the measured amplitude.

	Nominal Output		
SETUP	FREQUENCY	AMPLITUDE	Adjustment for:
65	100 kHz	3.0 V rms	100 kHz amplitude flatness
66	500 kHz	3.0 V rms	500 kHz amplitude flatness
67	1 MHz	3.0 V rms	1 MHz amplitude flatness
68	3 MHz	3.0 V rms	3 MHz amplitude flatness
69	5 MHz	3.0 V rms	5 MHz amplitude flatness
70	7 MHz	3.0 V rms	7 MHz amplitude flatness
71	9 MHz	3.0 V rms	9 MHz amplitude flatness
72	10 MHz	3.0 V rms	10 MHz amplitude flatness
73	10.5 MHz	3.0 V rms	10.5 MHz amplitude flatness
74	11 MHz	3.0 V rms	11 MHz amplitude flatness
75	11.5 MHz	3.0 V rms	11.5 MHz amplitude flatness
76	12 MHz	3.0 V rms	12 MHz amplitude flatness
77	12.5 MHz	3.0 V rms	12.5 MHz amplitude flatness
78	13 MHz	3.0 V rms	13 MHz amplitude flatness
79	13.5 MHz	3.0 V rms	13.5 MHz amplitude flatness
80	14 MHz	3.0 V rms	14 MHz amplitude flatness
81	14.5 MHz	3.0 V rms	14.5 MHz amplitude flatness
82	15 MHz	3.0 V rms	15 MHz amplitude flatness

4 Perform the Amplitude Flatness Verification procedures on page 60.

Shift Menu On/Off **Completion of adjustment procedures.** Return the function generator to the normal operating mode.

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EXITING
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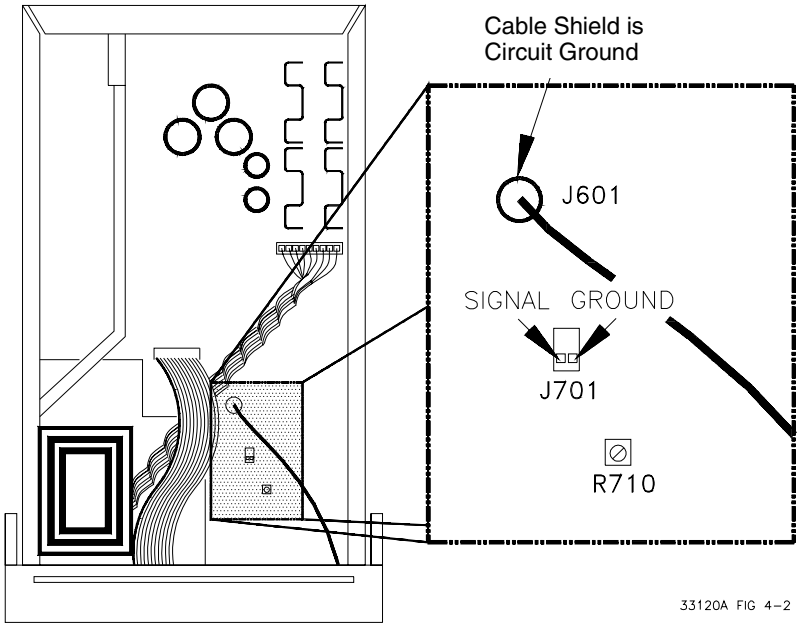
Output Amplifier Adjustment (Optional)

This adjustment procedure should only be performed following repairs to the Output Amplifier circuitry. The adjustment improves the high frequency performance of the Output Amplifier.

1 Remove the function generator power and cover as described on page 130.

2 Use a DMM to measure the ACrms voltage across J701 as shown below.



3 Turn on the function generator.

4 Set the function generator for a 1 kHz, 1V rms, sine wave output.

5 Adjust R710 for a *minimum* reading on the voltmeter. Typical readings are less than 0.005 Vrms.

6 Replace the covers as described on page 130.

Error Messages

The following tables are abbreviated lists of function generator's error messages. They are intended to include errors which are likely to be encountered during the procedures described in this chapter. For a more complete list of error messages and descriptions, see chapter 5 in the *Agilent 33120A User's Guide*.

System Error Messages

Error	Error Message
-330	Self-test Failed
-350	Too many errors
501	Isolator UART framing error
502	Isolator UART overrun error
511	RS-232 framing error
512	RS-232 overrun error
513	RS-232 parity error
514	Command allowed only with RS-232
521	Input buffer overflow
522	Output buffer overflow
550	Command not allowed in Local

Self-Test Error Messages

Error	Error Message
601	Front panel does not respond
602	RAM read/write fail
603	Waveform RAM readback failed
604	Modulation RAM readback failed
605	Serial configuration readback failed
606	Waveform ASIC failed
607	SYNC signal detection failure
608	SYNC signal detection failure
625	I/O Processor not responding
626	I/O Processor failed self-test
627	I/O Processor reset; possible low power line voltage

Calibration Error Messages

Error	Error Message
701	Cal security disabled by jumper
702	Cal secured
703	Invalid secure code
704	Secure code too long
705	Cal aborted
706	Cal value out of range
707	Cal signal measurement out of range
708	Flatness cal failed
709	Cannot calibrate frequency while externally locked (Option 001)
760	RAM checksum failure
850	Cal setup invalid
851	Negative offset gain cal required (CAL:SETup 50)
852	Flatness DAC gain cal required (CAL:SETup 64)
853	AM cal 1 required (CAL:SETup 30)
854	AM cal 2 required (CAL:SETup 31)
855	Cal load resistance not specified (CAL:SETup 33)
856	Square wave positive offset cal required (CAL:SETup 60)
857	Square wave 50% duty cycle cal required (CAL:SETup 62)
858	AM cal 3 required (CAL:SETup 32)

Theory of Operation

Theory of Operation

This chapter is organized to provide descriptions of the circuitry contained on the schematics shown in chapter 8. A block diagram overview is provided followed by more detailed descriptions of the circuitry contained in the schematics chapter.

The self-test procedures are described in chapter 6.

Block Diagram Overview

This discussion pertains to the block diagram shown on page 129.

The function function generator's circuitry is divided into two major blocks: the *floating section* and the *earth (ground) reference section*. All signal generation, control, and display functions are contained in the floating section. This section also contains the function generator's main CPU.

The floating section can be viewed in two pieces; the analog signal conditioning section (System DAC, Filters, Sync, Square wave, Pre-Attenuator, Output Amp, and Output Attenuator) and the digital logic section (Floating Logic, Digital Waveform Data Synthesis, and Waveform DAC).

All signal generation, level control, and modulation functions are performed in the floating section. The waveform DAC generates two outputs, normal and inverted, between approximately 800 mVp-p and 1 Vp-p. The DAC outputs are routed through anti-alias low-pass filters to eliminate higher frequency sampling products. The nominal x10 gain of the output amplifier, combined with preattenuator and output attenuator settings, are chosen such that the desired output amplitude is produced.

The ground reference section uses a processor configured as a slave to the main CPU. This processor establishes external I/O communication with the main CPU through a bi-directional, optically isolated, serial communications link. The earth referenced processor controls low-level GPIB (IEEE-488) and RS-232 interface operation. The ground referenced, rear panel external trigger input uses a dedicated optical isolator to couple a trigger signal to the main CPU in the floating section.

Separate power supplies are provided for the floating and ground reference sections. The front panel operates from the floating section with its logic common different from the CPU logic common.

Output Attenuator

Block 8 on block diagram page 129; Schematic on page 138.

The Output Attenuator provides 0 to 30 dB of signal attenuation between the output amplifier section and the output BNC connector. Output signal levels are controlled by combining coarse amplitude control from the output attenuator section and pre-attenuator section with fine amplitude control from the Waveform DAC AMP_CTL signal.

Four switched output attenuator pads are combined to achieve the desired signal attenuation as shown in the table below. Relays K801 through K804 either bypass an attenuator pad or select that attenuator. K801 selects a 2 dB attenuator, K802 selects a 4 dB attenuator, K803 selects a 8 dB attenuator, and K804 selects a 16 dB attenuator. Relays are sequenced to provide signal attenuation in 6 dB steps. Intermediate amplitude levels are controlled by selecting 0 dB, 2 dB or 4 dB of signal attenuation through the pre-attenuator solid state switches in combination with reducing the output level of the waveform DAC itself. The AMP_CTL signal provides smoothly varying control of the Waveform DAC output level over a 0 dB to -2 dB range. This operation is described further in the Waveform DAC and System DAC discussions.

Output Attenuation	K801	K802	K803	K804
0 dB	set	set	set	set
6 dB	reset	reset	set	set
12 dB	set	reset	reset	set
18 dB	reset	set	set	reset
24 dB	set	set	reset	reset
30 dB	reset	reset	reset	reset

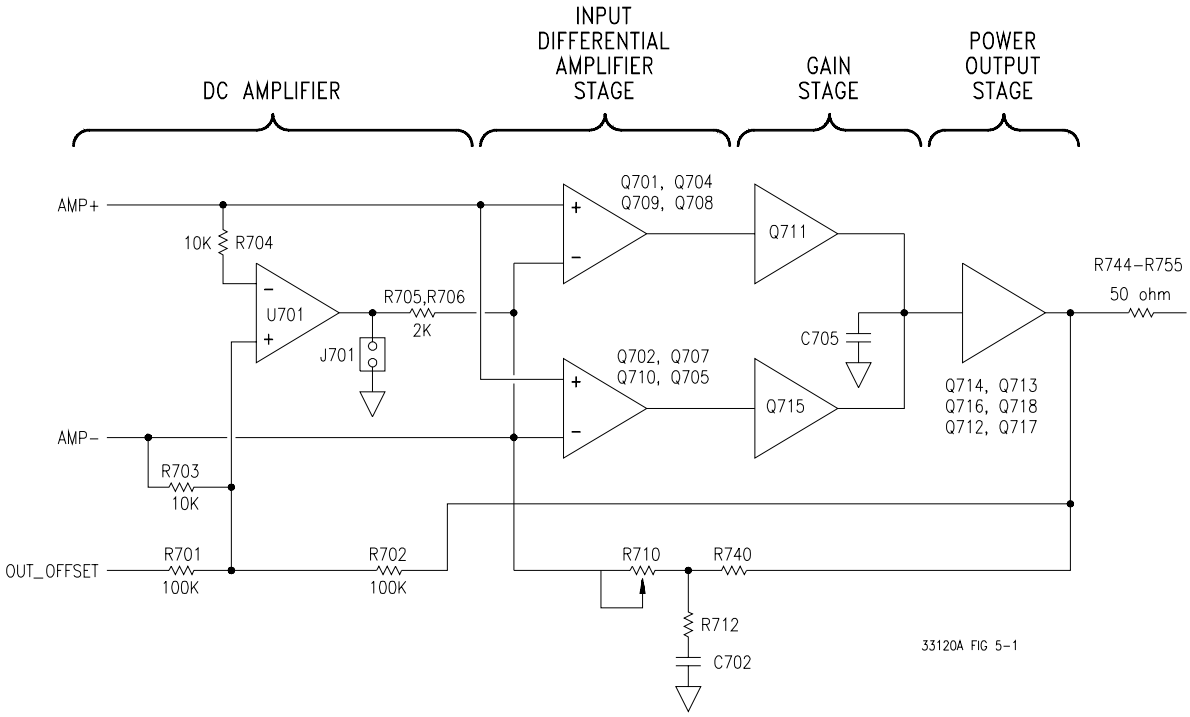
K801 through K804 are latching relays. Their set or reset state is selected by momentarily pulsing the appropriate coil of the relay. Relay coils are pulsed with 5 volts for 15 ms through relay drivers U301 and U302. The main controller, U102, writes data bytes to ASIC U103 which transmits this data to the relay drivers via the internal 3-wire serial data bus (SERCLK, SERDAT, and SERSTB) to accomplish the relay state changes.

A 30 MHz filter, composed of L801, C801, and C802, eliminates wideband noise from the function generator output. The output amplifier and output attenuators are protected from damage by clamps CR801 and CR802 and by fuse F801. The function generator is protected from accidental application of voltages <10 volts for short durations.

Output Amplifier

Block 7 on block diagram page 129; Schematic on page 137.

The output amplifier drives the function generator's signal output through the output attenuator section. The output amplifier exhibits an approximate 35 MHz bandwidth and 1000 V/µs slew rate. AC signals originating from the DAC+ and DAC- signal paths are combined at the input of the amplifier. The output amplifier exhibits a nominal x(-10) voltage gain from its -AMP_IN input and a nominal x12 voltage gain from its +AMP_IN input. A dc offset signal, related to the front panel output offset value, is also summed with the ac signal at the input of the amplifier. A simplified block diagram of the output amplifier is shown below.



The block diagram shows four basic stages: dc amplifier, input differential amplifier, gain, and power output. The amplifier's input differential amplifier stage and gain stage are symmetrical. The +AMP_IN and -AMP_IN inputs are both amplified through complementary amplifiers whose outputs are summed together at the input of the power output stage. Transistors Q701, Q702, Q704 and Q707 form the complementary input differential amplifiers. Q708 and Q705 are current sources which provide bias to the input differential amplifiers. Q709 and Q710 are emitter follower amplifiers used to couple the respective differential amplifier outputs to the gain stage transistors Q711 and Q715 which provide virtually all of the amplifiers open loop gain (~ x1000).

The power output stage is a wideband, class C buffer amplifier. Emitter followers Q714 and Q716 buffer the gain stage output from loading by the power output emitter follower transistors Q713 and Q718. Idle current bias for these power output transistors is set by the ratios of R732, R726 and transistor matching between Q713, Q714 and their equivalents in the other half of the stage: R734, R727 and Q718, Q716. Transistors Q712 and Q717 are current sources which provide bias to emitter followers Q714 and Q716 respectively.

The low frequency and dc performance of the amplifier is controlled by U702. This amplifier is used to sense the dc offset present at the +AMP_IN and -AMP_IN inputs and servo the output amplifier dc offset to zero volts; to the limit of U702's own dc offset performance. U702 also provides a means to add a desired dc offset value into the output signal path through the x (-1) gain of the OUT_OFFSET signal.

The output amplifier employs a current feedback technique to set the closed-loop gain. The emitters of Q701 and Q702 are the virtual summing node points in the amplifier. Amplifier closed loop gain is controlled predominately by the following ratios:

$$\frac{2 * (R740 + R710) + R717}{(R715 + R716)} \quad \text{and} \quad \frac{2 * (R740 + R710) + R711}{(R719 + R720)}$$

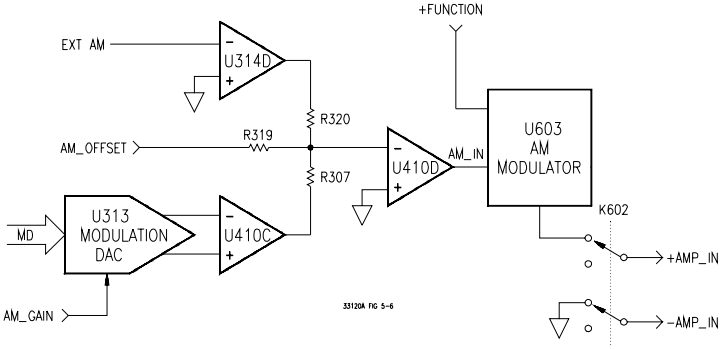
Variable resistor R710 is used to match the gain through the high frequency feedback path (described above) and the dc feedback path summed through resistors R705, R706. The feedback signal current is injected into the amplifier through the emitters of Q701 and Q702 respectively.

AM Modulation

Blocks 3 and 6 on block diagram page 129; Schematics on pages 136 and 133.

Amplitude modulation is performed by analog multiplier U603 combining the AM_IN and +FUNCTION and -FUNCTION signals. Modulation depths from 0% to 120% are set by varying the signal at AM_IN.

When the amplitude modulation function is selected, the output of U603 is switched into the +AMP_IN signal path by K602. At the same time, the -AMP_IN signal path is grounded, *cutting the output signal amplitude in half,* to accommodate the more than two times peak signal levels required by >100% modulation depth.



The AM_IN signal is a combination of any external modulation inputs applied to the rear panel BNC connector and the internally generated AM signals. The function generator can internally synthesize an 8-bit modulation wave shape through DAC U313. Data from any standard or arbitrary wave shape can be used as the modulating wave shape. Modulating wave shapes are automatically expanded or compressed in length, as required, to meet the specified modulating frequency setting. Changes in the function generator output will lag changes in the modulating frequency because new modulation data must be computed and downloaded internally for every frequency change.

The AM_GAIN and AM_OFFSET dc signals are used to calibrate and vary the am modulation depth settings. AM_GAIN controls the peak-to-peak output level from U313 in response to modulation depth setting changes. Likewise, the AM_OFFSET signal varies inversely to the AM_GAIN signal, as the AM depth setting is varied, to produce a constant signal offset in the composite AM_IN modulation signal. The net AM_IN offset is independent of the modulating ac signal component or AM depth setting.

Pre-attenuator

Block 6 on block diagram page 129; Schematic on page 136.

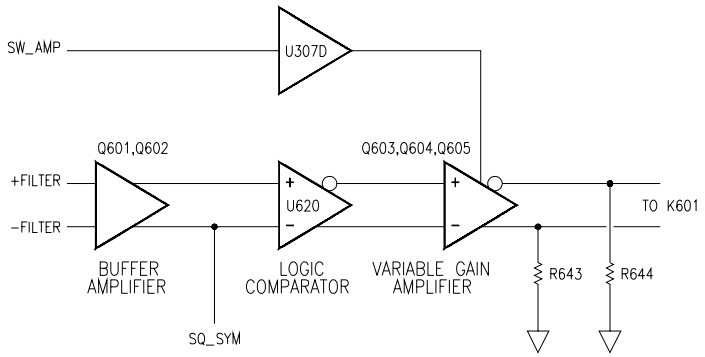
All signals, except square waves, pass through the preattenuator. The preattenuator multiplexes eight resistive 2 dB attenuators to provide attenuation from 0 dB to 14 dB in 2 dB steps. The 0 dB, 2 dB, and 4 dB attenuation steps are used for level settings between the 6 dB steps selected in the output attenuator section. Amplitude settings between these 2 dB steps are set by smoothly varying the Waveform DAC output level from 0 dB to -2 dB of its nominal level via the AMP_CTL signal. Output attenuator 6 dB steps, preattenuator 0 dB, 2 dB, and 4 dB steps, and small variations (0 dB to 2 dB) of the Waveform DAC output level are combined to produce each amplitude setting.

In the preattenuator, U601 and U602 are operated as 8-to-1 multiplexers, each providing selectable 2 dB attenuation steps. Because of the gain imbalance of the output amplifier (x 12 on +AMP_IN and x (-10) on -AMP_IN), the +signal path U601 has an additional 2 dB attenuation always present (R601 and R602) to equalize the nominal gains in both the plus and minus signal paths.

Square Wave and Sync

Block 6 on block diagram page 129, schematic on page 136.

During square wave outputs, a sine wave signal is generated internally and squared-up by comparator U620. Square wave amplitude control is accomplished by variable gain amplifier Q603 and Q604 and switched into the output signal path through relay K601. A simplified diagram of the square wave generator is shown below.



Transistors Q601 and Q602 buffer the output of the sine wave anti-alias filter to the input of comparator U620. Square wave duty cycles are controlled by the SQ_SYM input on the inverting input of the comparator. The squarewave outputs of U620 are amplified by variable gain amplifiers Q603 and Q604.

The amplifier gain output level is controlled by the variable current source Q605 and U307D in response to the System DAC dc signal SW_AMP. Squarewave variable gain amplifier output signal levels are unbalanced by resistors R643 and R644 to correct for the output amplifier + and - gain differences as discussed in the preattenuator section on page 90.

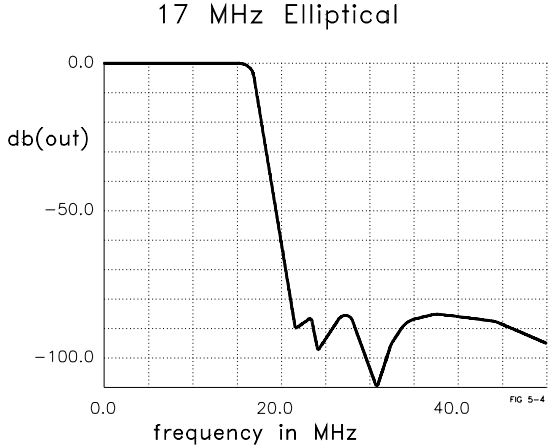
Latching relay K601 connects the square wave into the +FUNCTION and -FUNCTION paths. The relay set or reset state is selected by momentarily pulsing the appropriate coil. Relay coils are pulsed with 5 volts for 15 ms through relay driver U301. The main controller, U102, writes data bytes to ASIC U103 which transmits this data to the relay drivers via the internal 3-wire serial data bus (SERCLK, SERDAT, and SERSTB) to accomplish relay state changes.

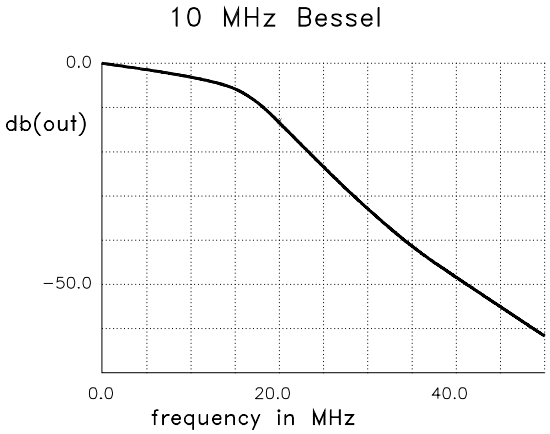
Multiplexer U604 selects one of five sources for the SYNC output: off, modulation sync, square wave comparator output, RUN*, or Arbitrary waveform sync. ARB_SYNC is derived from the WA14 line through U210B. U215B and U210C control the pulse width of the ARB_SYNC (arbitrary waveform sync) signal. Square wave sync is taken from the inverting output of square wave comparator U620. U620 also generates the MOD_SYNC (modulation sync) through U217. Buffer U621 inverts the sync signal and provides the output current drive to the SYNC output BNC connector.

Filters

Block 5 on block diagram page 129; Schematic on page 135.

The output of the Waveform DAC passes through one of two anti-alias filters. A 17 MHz 9th order elliptical filter is used for the sine wave and square wave output functions. A 10 MHz 7th order Bessel filter is used for filtering all other output functions, including all arbitrary waveshapes. The diagrams below show the typical frequency response of these filters.



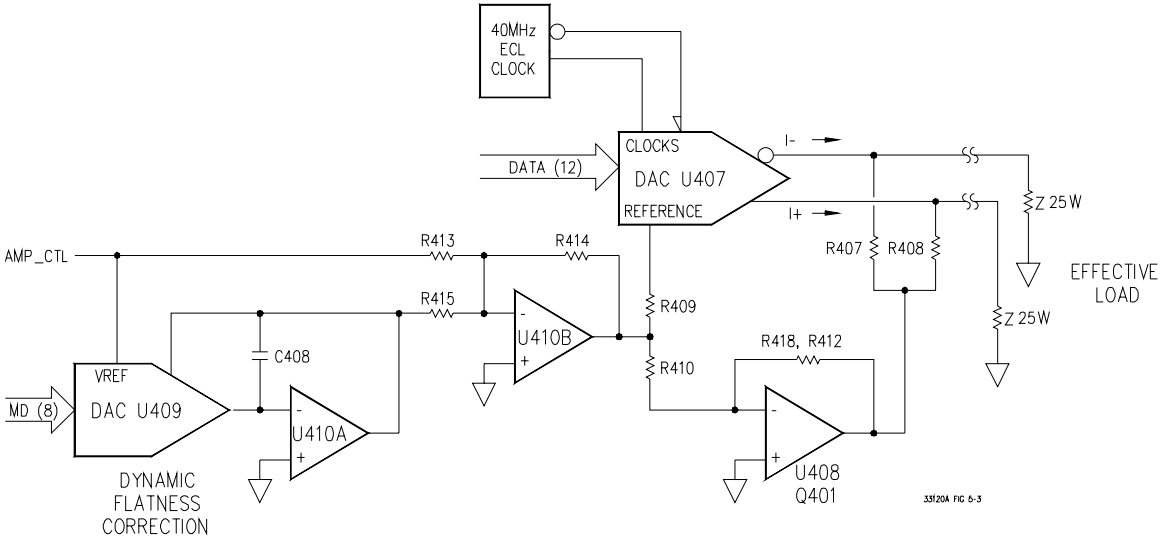


The filters are switched in or out of the signal path by latching relays K501 and K502. Their set or reset state is selected by momentarily pulsing the appropriate coil of the relay. Relay coils are pulsed with 5 volts for 15 ms through relay drivers U301 and U302. The main controller, U102, writes data bytes to ASIC U103 which transmits this data to the relay drivers via the internal 3-wire serial data bus (SERCLK, SERDAT, and SERSTB) to accomplish these relay state changes. When K501 and K502 are set, the 10 MHz Bessel filter is selected.

Waveform DAC/Amplitude Leveling/Waveform RAM

Block 4 on block diagram page 129; Schematic on page 134.

The Waveform DAC, U407, converts 12-bit digital data from waveform RAM's U404 and U405 into positive and negative analog voltages. A simplified diagram of the Waveform DAC circuitry is shown below.



The preattenuator, filters, and associated circuits in the output signal path provide an approximate 25Ω load for the Waveform DAC. The Waveform DAC nominally produces a 40 mA differential output current — yielding differential 1 Vac output signals. Wave shape (amplitude) data is loaded into the waveform RAM by the main controller CPU U102. Once loaded, these data are addressed by the DDS ASIC. The rate at which addresses are incremented determines the output waveform frequency. Waveform RAM output data is latched and shifted to ECL levels by U402 and U403 for input to the waveform digital-to-analog converter (DAC) U407. DDS ASIC U206, waveform data latches U402 and U403, and the Waveform DAC U407 are clocked at 40 MHz. The 40 MHz clock is generated by oscillator U413 and ECL level-shifter U401.

The Waveform DAC voltage reference is driven by U410B. This reference controls the magnitude of the nominal 0 to -40 mA DAC output current. The reference level is varied to produce 0 to -2 dB fine amplitude level control via dc signal AMP_CTL and ±2 dB of dynamic amplitude flatness correction for static and swept frequency operation via flatness correction dac U409. These reference voltage adjustments are summed together in amplifier U410B. Amplitude flatness correction data are stored in calibration memory during calibration. These data are used to produce a modulation program with corresponding 8-bit amplitude correction data values which are gated to latch U412 during operation. These data provide real-time correction of the output amplitude level as frequency changes are made. Amplifier U408 and Q401 use the waveform DAC reference voltage to center the waveform DAC output signal near 0 volts.

U404 and U405 are the high-speed waveform RAM. Together, U404 and U405 form a 16383 x 12-bit RAM. Each RAM stores and outputs 6 bits of the waveform DAC 12-bit WD data bus. RAM U404 drives the least significant 4 bits and U405 drive the most significant 8 bits of the WD data bus. Note that DAC U407 calls D1 the most-significant bit (MSB) and D12 it's least-significant bit (LSB). Waveform RAM addresses are controlled by the DDS ASIC's WA (waveform address) bus.

Direct Digital Synthesis (DDS ASIC)

Block 2 on block diagram page 129; Schematic on page 132.

The DDS ASIC, U206, controls the WA (waveform address) and MA (modulation address) busses. The waveform address is used by the waveform RAMs U404 and U405. The modulation data bus is used by the modulation RAM U205.

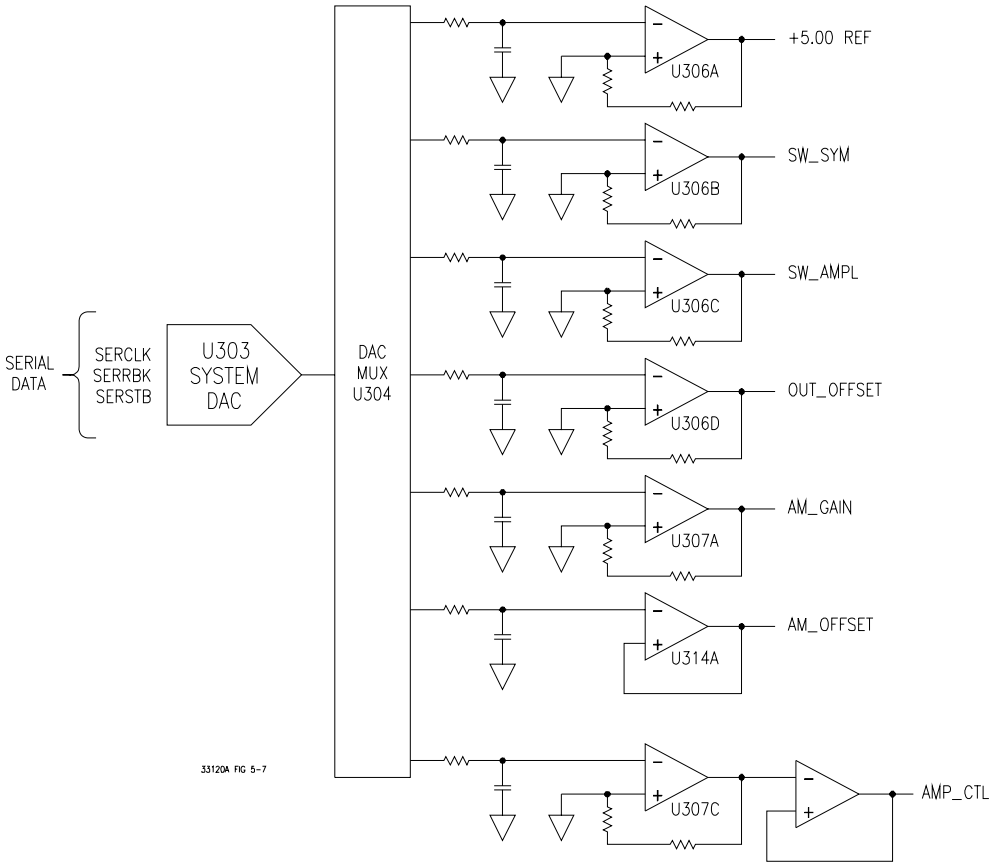
The DDS ASIC is comprised of several internal registers and addressing state machines. Instructions are written to the DDS ASIC by the main CPU via memory mapped control registers U108 and U202. When loading data into Waveform RAM or Modulation RAM, addresses on the WA and MA busses are incremented by ASIC U206. ASIC addresses are incremented by each rising edge of the TRIG line while writing data into these RAM. The state of the HOST_RQ* line controls whether the main CPU or the modulation RAM U205 is sourcing instructions to the DDS ASIC internal state machines. The Modulation RAM is loaded with frequency values and amplitude flatness correction values or AM modulation data for latch U309 and AM dac U313. Data multiplexer U217 and flip-flop U215 are used to preselect and synchronize the modulation sync source available to the SYNC output terminal multiplexer U604.

The external trigger input OGEXT is optically isolated by U213 and applied to an input of trigger source multiplexer U214. The external trigger input is used for triggering the start of a frequency sweep or burst output and for externally gating the output signal on and off asynchronously. U214 selects one of seven trigger sources for use by U206 for initiating its internal program.

System DACs

Block 3 on block diagram page 129; Schematic on page 133.

All output amplitudes are derived from the internal voltage reference of System DAC U303. The system dac track/hold amplifier outputs are used to provide controllable bias voltages to various analog circuits including AM modulation depth, square wave amplitude, square wave duty cycle, output dc offset, and output amplitude level. The System DAC is programmed and responds to the main controller via the internal 3-wire serial data bus SERCLK, SERRBK, and SERSTB. The System DAC is multiplexed to 7 track/hold amplifiers through U304. Each track/ hold amplifier is refreshed approximately every 3 ms to maintain its output setting. Changes to track/hold amplifier outputs are accomplished by dwelling on that position for an extended period.



Floating Logic

Block 1 on block diagram page 129; Schematic on page 131.

The floating logic controls the operation of the entire function function generator. All output functions and bus command interpretation is performed by the main CPU, U102. The front panel and earth referenced logic operate as slaves to U102. The main CPU portion of the floating logic section is clocked from a 12 MHz ceramic resonator, Y101. Non-volatile EEPROM U106 stores arbitrary waveform data, calibration constants, calibration secure code, calibration count, and last instrument state.

The main CPU, U102, is a 16-bit micro controller. The 16-bit A (address) bus and 8-bit AD (address/data) bus are used to provide digital communication with the 256k byte program ROM U104, 32k byte RAM U105, 128k byte non-volatile EEPROM U106, 32k byte high speed Modulation RAM U205, 16k x 12-bit high speed waveform RAM U404 and U405 and DDS ASIC U206.

Gate array U103 provides CPU address latching and memory mapping functions. There are four internal registers in U103: a configuration register, an 8-bit counter register, a serial transmit/receive register, and an internal status register. RAM chip select signal RAMCE* and CPU port bits RAMA13 and RAMA14 are used to access 4 - 8k byte banks of program data RAM. Similarly, 4 banks of 56k non-volatile EEPROM and 2 banks of 56k non-volatile RAM are gated from CPU port bits PRG16, PRG17, and WAVA16 and U103 signal ROMCE*. Addresses on the CPU address bus are valid when the ALE line is high. Memory mapping of control of registers U107 and U202, DDS ASIC U206, data transceivers U201, U203, U204, and write enables for RAM U404 and U405 and U205 are controlled by data selector U108.

The U103 serial register controls the front panel, relay drivers U301 and U302, and System DAC U303 through a serial data bus. Front panel signals are FPDI, FPSK*, and FPDO. Interrupts from the front panel are detected by U103 and signaled to U102 by CHINT. The FPINT line from U102 signals the front panel that U103 has data to send. The internal 3-bit serial data bus (U102) uses SERCK, SERDAT, and SERSTB to send data to various registers. SERRBK (serial read back) is used by self test to verify operation of U103, relay drivers U301, U302, and System DAC shift register U305.

The main CPU, U102, communicates with the earth referenced logic through an optically isolated asynchronous serial data link. U101 isolates the incoming data (OG_RXD*) from the earth referenced logic. Similarly, U901 isolates the data from U102 (OG_TXD) to the earth reference logic. Data is sent in an 11-bit frame at a rate of 187.5 k bits/second. When the RS-232 interface is selected, data is sent across the serial link at 93.75 k bits/second. The 11-bit internal data frame is configured for one start bit, eight data bits, one control bit, and one stop bit.

Earth-Referenced Logic

Block 9 on block diagram page 129; Schematic on page 139.

The earth referenced section provides all rear panel input/output capability. Microprocessor U903 handles GPIB (IEEE-488) control through bus interface chip U904 and bus receiver/driver chips U907 and U908. The RS-232 interface is also controlled through U903. RS-232 transceiver chip U906 provides the required level shifting to approximate ± 9 volt logic levels through on-chip charge-pump power supplies using capacitors C904 and C906. Communication between the earth referenced logic interface circuits and the floating logic is accomplished through an optically-isolated bi-directional serial interface. Isolator U101 couples data from U903 to microprocessor U102. Isolator U901 couples data from U102 to microprocessor U903.

Power Supplies

Block 10 on block diagram page 129; Schematic on page 140.

The power supply section, is divided into two isolated blocks similar to the floating logic and earth referenced logic sections discussed earlier. The floating supply outputs are ± 18 Vdc, +5 Vdc, -5.2 Vdc (VEE), and a 6 Vrms center tapped filament supply for the vacuum fluorescent display. All earth referenced logic is powered from a single +5 Vdc supply. Power-on reset signals are provided by both the floating and earth referenced power supplies. In addition, the floating section +5 Vdc supply incorporates a power failure detection circuit which provides a priority interrupt signal to the main CPU (U102).

The ac mains are connected by a fused power entry module, P1. This module incorporates the functions of mains connection, on/off switching, fusing, and line voltage selection (100/120/220 (230)/240). The line voltage selection function of module P1 selects which primary winding of power transformer T1 is energized. The transformer secondary windings are connected to the main pc board through connector J1001.

The floating +5 Vdc and -5.2 Vdc supplies are produced by a bridge rectifier formed by diodes CR1006 through CR1009, filter capacitors C1005 and C1009, and voltage regulators U1003 and U1004. U1005 and CR1011 form a clamp circuit to provide over voltage protection in the event of a mains or transformer failure. The PFAIL and PONRST* signals are derived from the floating +5 Vdc supply. PFAIL is asserted when the raw 5 Vdc supply drops below 6.4 V signaling an unstable power supply condition to the main CPU (U102). Current instrument state information is copied to non-volatile RAM, U106 for future recall if needed. The PONRST* signal holds the main CPU and other logic in a reset state until after the +5 Vdc logic power supply is fully operational. This signal is generally active only following application of line power to the instrument.

The floating ±18 volt supplies are produced by bridge rectifier CR1001, filter capacitors C1001 and C1003, and regulators U1001 and U1002. These supplies are used to power all analog circuits in the function generator. In addition, the vacuum fluorescent display is driven from the ± 18 volt supplies. A separate winding of T1 provides a center tapped 6 Vrms filament supply for the display. Bias circuit CR1010, R1009, and C1011 generate the required cathode dc bias for the display filament supply.

The 5 volt earth referenced supply is produced by rectifier CR1051, C1053, and regulator U1051. This supply is earth referenced through the screw used to mount the PC board to the instrument chassis. The GPIB (IEEE-488) and RS-232 computer interfaces and the rear-panel EXT Trigger circuits are powered from this supply. A controlled power-on reset signal for processor U903 is generated by U1052.

Display and Keyboard

Block 11 on block diagram page 129; Schematic on page 141.

The front panel circuits consist of vacuum fluorescent display control, display high voltage drivers, and keyboard scanning. Communication between the front panel and floating logic circuits is accomplished through a 4-wire bi-directional serial interface. The main CPU, U102, can cause a hardware reset to processor U1101 by signal IGFPRES. The front panel logic operates from -13 volts (logic 1) and -18 volts (logic 0). The four serial communication signals are level shifted by comparator U1301 from the floating logic 0 V to 5 V levels to the -18 V to -13 V levels present on the front panel assembly. The front panel logic high supply (-13 volts) is produced from the -18 volt supply by voltage regulator U1102.

Display anode and grid voltages are +18 volts for an on segment and -18 volts for an off segment. The -12 V cathode bias for the display is provided by the main pc board's filament winding center tap bias circuit CR1010, R1009, and C1011 shown on the power supply schematic (*see page 140*).

Keyboard scanning is accomplished through a conventional scanned row-column key matrix. Keys are scanned by outputting data at microprocessor U1101 port pins P0.0 through P0.4 to poll each key column for a key press. Column read-back data are read by the microprocessor at port pins P1.0 through P1.3 for decoding and communication to the floating logic circuits. Rotary knob quadrature inputs are read directly by the microprocessor port pins P1.6 and P1.7.

Service

Service

This chapter discusses the procedures involved for returning a failed function generator to Agilent for service or repair. Subjects covered include the following:

Operating Checklist

Before returning your function generator to Agilent for service or repair, check the following items:

Is the function generator inoperative?

- ☐ Verify that the ac power cord is connected to the function generator.
- ☐ Verify that the front-panel Power switch is depressed.
- ☐ Verify that the power-line fuse is good (see page 22).
  The function generator is shipped from the factory with a 500 mAT fuse installed. This is the correct fuse for all line voltages.
- ☐ Verify the power-line voltage setting.
  See "To prepare the function generator for use" on page 21.

Does the function generator fail self-test?

- ☐ Verify that the correct power-line voltage is selected.
  See "To prepare the function generator for use" on page 21.

Is the function generator's output inoperative?

- ☐ Turn off the function generator and remove the power cord. Using an ohmmeter, measure the resistance between the output BNC center conductor and case. If the ohmmeter measures >100Ω, the internal output protection fuse, F801, may be open.

Types of Service Available

If your function generator fails during the warranty period (within three years of original purchase), Agilent will replace or repair it free of charge. After your warranty expires, Agilent will repair or replace it at a competitive price. The standard repair process is “whole unit exchange”. The replacement units are fully refurbished and are shipped with new calibration certificates.

Standard Repair Service (worldwide)

Contact your nearest Agilent Technologies Service Center. They will arrange to have your function generator repaired or replaced.

Agilent Express Unit Exchange (U.S.A. only)

You will receive a refurbished, calibrated replacement Agilent 33120A in 1 to 4 days.

1 Call 1-877-447-7278 and ask for “Agilent Express”.

- You will be asked for your serial number, shipping address, and a credit card number to guarantee the return of your failed unit.
- If you do not return your failed unit within 15 business days, your credit card will be billed for the cost of a new 33120A.

2 Agilent will immediately send a replacement 33120A directly to you.

- The replacement unit will come with instructions for returning your failed unit. Please retain the shipping carton and packing materials to return the failed unit to Agilent. If you have questions regarding these instructions, please call 1-877-447-7278.
- The replacement unit will have a different serial number than your failed unit. If you need to track your original serial number, a blank label will be shipped with the replacement unit to record your original serial number.

Repackaging for Shipment

If the unit is to be shipped to Agilent for service or repair, be sure to:

- Attach a tag to the unit identifying the owner and indicating the required service or repair. Include the instrument model number and your full serial number.
- Place the unit in its original container with appropriate packaging material.
- Secure the container with strong tape or metal bands.

If the original shipping container is not available, place your unit in a container which will ensure at least 4 inches of compressible packaging material around all sides for the instrument. Use static-free packaging materials to avoid additional damage to your unit.

Agilent suggests that you always insure shipments.

Cleaning

Clean the outside of the instrument with a soft, lint-free, slightly dampened cloth. Do not use detergent. Disassembly is not required or recommended for cleaning.

Electrostatic Discharge (ESD) Precautions

Almost all electrical components can be damaged by electrostatic discharge (ESD) during handling. Component damage can occur at electrostatic discharge voltages as low as 50 volts.

The following guidelines will help prevent ESD damage when servicing the function generator or any electronic device.

- Disassemble instruments *only* in a static-free work area.
- Use a conductive work area to dissipate static charge.
- Use a conductive wrist strap to dissipate static charge accumulation.
- Minimize handling.
- Keep replacement parts in original static-free packaging.
- Remove all plastic, styrofoam, vinyl, paper, and other static-generating materials from the immediate work area.
- Use *only* anti-static solder suckers.

WARNING

SHOCK HAZARD. Only service-trained personnel who are aware of the hazards involved should remove the instrument covers. To avoid electrical shock and personal injury, make sure to disconnect the power cord from the function generator before removing the covers.

Surface Mount Repair

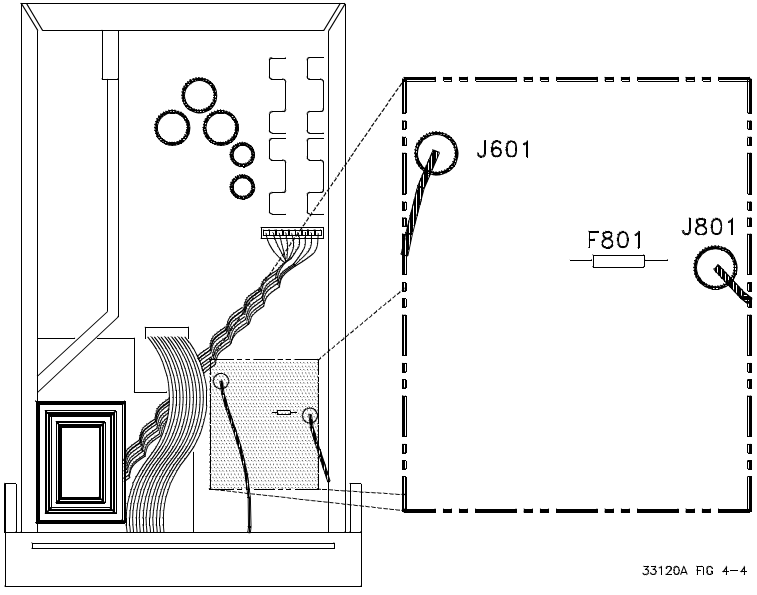
Surface mount components should *only* be removed using soldering irons or desoldering stations *expressly* designed for surface mount components. *Use of conventional solder removal equipment will almost always result in permanent damage to the printed circuit board and will void your Agilent factory warranty.*

To Replace the Power-Line Fuse

The power-line fuse is located within the function generator's fuse-holder assembly on the rear panel (*see page 22*). The function generator is shipped from the factory with a 500 mAT slow-blow fuse installed (part number 2110-0458). This is the correct fuse for all line voltages.

To Replace the Output Protection Fuse (F801)

The Output Protection Fuse is located inside the function generator. This fuse is a thru-hole soldered 500 mA part (part number 2110-0716). The fuse is located near the output connector (J801) on the main PC board. You will need to disassemble the function generator to replace this fuse (use a TORX T-15 driver to remove the screws located on the rear panel). The disassembly procedure is shown on page 130.



Troubleshooting Hints

This section provides a brief checklist of common failures. Before troubleshooting or repairing the function generator, make sure the failure is in the instrument rather than any external connections. Also make sure that the instrument is accurately calibrated. The function generator's circuits allow troubleshooting and repair with basic equipment such as a 6½-digit multimeter and a 100 MHz oscilloscope.

Unit is Inoperative

- ☐ Verify that the ac power cord is connected to the function generator.
- ☐ Verify that the front-panel Power switch is depressed.
- ☐ Verify that the power-line fuse is good (see page 22).
  The function generator is shipped from the factory with a 500 mAT fuse installed. This is the correct fuse for all line voltages.
- ☐ Verify the power-line voltage setting.
  See "To prepare the function generator for use" on page 21.

Unit Reports Error 760

This error may be produced if you accidentally turn off power the unit during a calibration or while changing a non-volatile state of the instrument. Recalibration or resetting the state should clear the error. If the error persists, a hardware failure may have occurred.

Unit Fails Self-Test

Verify that the correct power-line voltage setting is selected. Also, ensure that all terminal connections (both front panel and rear terminals) are removed while the self-test is performed. Failure of the System DAC U03 will cause many self-test failures.

Power Supply Problems

WARNING

SHOCK HAZARD. Only service-trained personnel who are aware of the hazards involved should remove the instrument covers. The procedures in this section require that you connect the power cord to the instrument with the covers removed. To avoid electrical shock and personal injury, be careful not to touch the power-line connections.

- ☐ Check that the input to the supply voltage regulator is at least 1 volt greater than its output.
- ☐ Circuit failures can cause heavy supply loads which may pull down the regulator output voltage.
- ☐ Check the main supply voltages as tabulated below.

Power Supply	Minimum	Maximum
+5 Ground Ref.	4.75V	5.25V
+5 Floating	4.75V	5.25V
-5.2 Floating	-5.46V	-4.94V
+18 Floating	17.0V	19.1V
-18 Floating	-19.1V	-17.0V
+5REF Floating	4.75V	5.25V

- ☐ Some circuits produce their own local power supplies derived from the main supplies. Be sure to check that these local supplies are active. In particular, the output amplifier and front panel sections have local supplies. Always check that the power supplies are free of ac oscillations using an oscilloscope.

Self-Test Procedures

Power-On Self-Test

Each time the function generator is powered on, a small set of self-tests are performed. These tests check that the minimum set of logic and measurement hardware are functioning properly. The power-on self-test performs checks 601, 625, and 626.

Complete Self-Test

Hold the shift key while turning on the power to perform a complete self-test. The tests are performed in the order shown below.

Performing Individual Tests

You can perform individual self-tests through the SYStem menu and TEST command. The parameters allowed are ALL, 603, 604, 605, 606, 607, and 608. All numbered tests are looped to give a continuous pass/fail indication when started from the menu (they will repeat the waveform or sync signal until interrupted).

601 **Front panel does not respond** The main CPU U102 attempts to establish serial communications with the front panel processor U1101. During this test, U1101 turns on all display segments. Communication must function in both directions for this test to pass. If this error is detected during power-up self-test, the function generator will beep twice. This error is only readable from the remote interface.

602 **RAM read/write failed** This test writes and reads a 55_H and AA_H checker board pattern to each address of ram U103. Any incorrect readback will cause a test failure.

603 **Waveform RAM readback failed** This test writes and reads a $A55_H$ and $5AA_H$ checker board pattern (12-bit) to each address of waveform ram U404 and U405. The test writes and reads the pattern twice, at alternating addresses. Any incorrect readback will cause a test failure.

604 **Modulation RAM readback failed** This test writes and reads a $5A_H$ and $A5_H$ checker board pattern (8-bit) to each address of Modulation ram U205. The test writes and reads the pattern twice, at alternating addresses. Any incorrect readback will cause a test failure.

605 **Serial configuration readback failed** This test re-sends the last 3 byte serial configuration data to all the serial path (SERDAT, SERBCK, SERCLK). The data is then clocked back into U103 and compared against the original 3 bytes sent. A failure occurs if the data do not match. This tests checks the serial data path through U301, U302, and U305. This tests does not check the serial path to the system DAC U303.

606 **Waveform ASIC failed** This test is the first part of test 607 (below). This test sets up a burst modulation program of a special waveform (a four period ramp wave) where the data at each waveform address is the same as the last 12 bits of its address. The burst modulation waveform is run for 1 cycle plus 1 address and the waveform data is read back and compared. A correct result infers that the modulation program ran correctly and halted at the correct address. This checks the ability of U205 and U206 to correctly run a burst modulation program. This test and test 604 give a high confidence in the modulation circuitry. This test will fail if a trigger signal is present on the rear panel Ext Trig BNC input.

607 **SYNC signal detection failure, Bessel filter path** This test runs the special waveform described in test 606 and counts transitions of the SYNC line. The test should provide 8 transitions of the SYNC signal. The test also checks the 7th Order Bessel filter path and U620 and U604. An incorrect number of transitions will generate an error. This test will fail if a trigger signal is present on the rear panel Ext Trig BNC input.

608 **SYNC signal detection failure, Elliptical filter path** This test runs a special waveform and counts transitions of the SYNC line. The test should provide 2 transitions of the SYNC line. The test checks the 9th Order Elliptical filter path. An incorrect number of transitions will generate an error. This test will fail if a trigger signal is present on the rear panel Ext Trig BNC input.

625 **I/O processor does not respond** This test checks that communications can be established between U102 and U903 through the optically isolated (U101 and U901) serial data link. Failure to establish communication in either direction will generate an error. If this condition is detected at power-on self-test, the function generator will beep and the error annunciator will be on.

626 **I/O processor failed self-test** This test causes the earth referenced processor U903 to execute an internal, ram test. Failure will generate an error.

701 Checks that the calibration security disable jumper is removed. If the jumper is shorted at power on, all non-volatile RAM is reset to initial factory values.

Replaceable Parts

Replaceable Parts

This chapter contains information to help you order replacement parts for your 33120A Function Generator. The parts lists are divided into the following groups:

- 33120-66521 Main PC Assembly (A1)
- 33120-66502 Front-Panel Display and Keyboard PC Assembly (A2)
- 33120A Mainframe
- Manufacturer's List

Parts are listed in alphanumeric order according to their schematic reference designators. The parts lists include a brief description of the part with applicable Agilent part number and manufacturer part number.

To Order Replaceable Parts

You can order replaceable parts from Agilent using the Agilent part number or directly from the manufacturer using the manufacturer's part number. Note that not all parts listed in this chapter are available as field-replaceable parts. To order replaceable parts from Agilent, do the following:

1 Contact your nearest Agilent Sales Office or Agilent Service Center.

2 Identify the parts by the Agilent part number shown in the replaceable parts list. Note that not all parts are directly available from Agilent; you may have to order certain parts from the specified manufacturer.

3 Provide the instrument model number and serial number.

■ 33120-66521 – Main PC Assembly

Reference Designator	Agilent Part Number	Qty	Part Description	Mfr. Code	Mfr. Part Number
C101-C102	0160-6497	78	CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C103-C105	0160-5945	26	CAP-FXD 0.01 uF 50 V	04222	08055C103KAT A
C107	0160-5945		CAP-FXD 0.01 uF 50 V	04222	08055C103KAT A
C108	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C109-C110	0160-5945		CAP-FXD 0.01 uF 50 V	04222	08055C103KAT A
C111-C113	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C114-C117	0160-5945		CAP-FXD 0.01 uF 50 V	04222	08055C103KAT A
C201-C202	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C203	0160-5945		CAP-FXD 0.01 uF 50 V	04222	08055C103KAT A
C204	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C205	0160-5945		CAP-FXD 0.01 uF 50 V	04222	08055C103KAT A
C206-C207	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C208-C210	0160-5945		CAP-FXD 0.01 uF 50 V	04222	08055C103KAT A
C211-C213	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C301-C306	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C308-C309	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C310-C312	0160-5945		CAP-FXD 0.01 uF 50 V	04222	08055C103KAT A
C313-C318	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C319	0160-5945		CAP-FXD 0.01 uF 50 V	04222	08055C103KAT A
C320	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C401-C402	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C404	0160-5967	6	CAP-FXD 100 pF 50 V	04222	08051A101JAT A
C405	0160-5962	2	CAP-FXD 15 pF 50 V	04222	08051A150JAT A
C406	0160-5967		CAP-FXD 100 pF 50 V	04222	08051A101JAT A
C407	0160-5962		CAP-FXD 15 pF 50 V	04222	08051A150JAT A
C408	0160-5967		CAP-FXD 100 pF 50 V	04222	08051A101JAT A
C409	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C410	0160-5945		CAP-FXD 0.01 uF 50 V	04222	08055C103KAT A
C411	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C412	0160-5945		CAP-FXD 0.01 uF 50 V	04222	08055C103KAT A
C413-C422	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C423	0160-5959	1	CAP-FXD 33 pF 50 V	04222	08051A330JAT A
C424	0160-5947	4	CAP-FXD 1000 pF 50 V	04222	08055C102KAT A
C425	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C426-C427	0160-6736	2	CAP-FXD 0.01uF +-10% 50 V CER X7R	51406	GRM426X7R103K50
C428	0160-5967		CAP-FXD 100 pF 50 V	04222	08051A101JAT A
C429-C432	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C503-C504	0160-7405	2	CAP-FXD 560 pF +-10% 50 V CER X7R	28480	0160-7405
C505-C506	0160-5953	5	CAP-FXD 270 pF 50 V	02444	08051A271JAT A
C507-C508	0160-5964	3	CAP-FXD 180 pF 50 V	04222	08051A181JATRA
C509-C510	0160-5958	2	CAP-FXD 39 pF 50 V	04222	08051A390JAT A
C521-C522	0160-5954	3	CAP 220 pF 5% 50V	04222	08051A221JAT A
C531-C532	0160-5955	4	CAP-FXD 68 pF 50 V	04222	08051A680JATRA
C533-C534	0160-5976	2	CAP-FXD 12 pF 50 V	04222	08051A120JAT A

Reference Designator	Agilent Part Number	Qty	Part Description	Mfr. Code	Mfr. Part Number
C535-C536	0160-5952	2	CAP-FXD 330 pF 50 V	04222	08055A331JAT A
C539-C540	0160-7721	2	CAP-FXD 82 pF +-1% 50 V CER C0G	04222	08055A820FATMA
C541-C542	0160-5965	2	CAP-FXD 150pF +-5% 50 V CER C0G	04222	08051A151JAT A
C543-C544	0160-5967		CAP-FXD 100 pF 5%	04222	08051A101JAT A
C545-C546	0160-7733	2	CAP-FXD 100 pF +-1% 50 V CER C0G	04222	08055A101FAT_A
C547-C548	0160-5953		CAP-FXD 270 pF 50 V	04222	08051A271JAT A
C551-C552	0160-5961	2	CAP-FXD 22 pF 50 V	04222	08051A220JAT A
C553-C554	0160-5965		CHIP CAPACITOR	04222	08051A151JAT A
C601-C607	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C608	0160-5954		CAP 220 pF 5% 50V	04222	08051A221JAT A
C623	0180-3975	5	CAP-FXD 2.2 uF 20 V TA	04222	TAJB225M020
C624	0160-5945		CAP-FXD 0.01 uF 50 V	04222	08055C103KAT A
C630	0160-5945		CAP-FXD 0.01 uF 50 V	04222	08055C103KAT A
C631	0160-5955		CAP-FXD 68 pF 50 V	04222	08051A680JATRA
C632-C633	0160-5957	2	CAP-FXD 47 pF	04222	08051A470JAT A
C702	0160-5953		CAP-FXD 270 pF 50 V	02444	08051A271JAT A
C703-C704	0160-5975	3	CAP-FXD 10 pF 50 V	04222	08051A100JAT A
C705	0160-5942	2	CAP-FXD 1 pF 50 V	04222	08051A1R0CAT A
C706-C707	0180-3975		CAP-FXD 2.2 uF 20 V TA	04222	TAJB225M020
C709	0160-5975		CAP-FXD 10 pF 50 V	04222	08051A100JAT A
C710	0180-3975		CAP-FXD 2.2 uF 20 V TA	04222	TAJB225M020
C711	0180-3859	2	CAP-FXD 1000 uF+-20% 35 VDC	S4217	SME35VB102M12.5X25LL
C712	0180-3975		CAP-FXD 2.2 uF 20 V TA	04222	TAJB225M020
C713	0180-3859		CAP-FXD 1000 uF+-20% 35 VDC	S4217	SME35VB102M12.5X25LL
C714-C719	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C720	0160-5942		CAP-FXD 1 pF 50 V	04222	08051A1R0CAT A
C802	0160-5964		CAP-FXD 180 pF 50 V	04222	08051A181JATRA
C901	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C902	0160-5955		CAP-FXD 68 pF 50 V	04222	08051A680JATRA
C903-C906	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C908	0160-5945		CAP-FXD 0.01 uF 50 V	04222	08055C103KAT A
C909-C911	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C913	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C1001	0180-4313	2	CAP 2200 uF 50V	S4217	KME50VB222M18X35LL
C1002	0180-3751	3	CAP-FXD 1 uF 35 V TA	04222	TAJB105M035
C1003	0180-4313		CAP-FXD 2200 uF 50V	S4217	KME50VB222M18X35LL
C1004	0180-3751		CAP-FXD 1 uF 35 V TA	04222	TAJB105M035
C1005	0180-4086	2	CAP-FXD .01 F+-20% 25 VDC AL	S4217	SME25VN103M22X45LL
C1006	0180-3751		CAP-FXD 1 uF 35 V TA	04222	TAJB105M035
C1007-C1008	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C1009	0180-4589	1	CAP-FXD +-20% 16 V AL-ELCTLT	S4217	SMH16VN153M22X35LL
C1010-C1011	0180-4116	4	CAP-FXD 22 uF 20 V TA	04222	TAJD226M020
C1013	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C1014	0180-4116		CAP-FXD 22 uF 20 V TA	04222	TAJD226M020
C1015-1016	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A

Reference Designator	Agilent Part Number	Qty	Part Description	Mfr. Code	Mfr. Part Number
C1017-1019	0160-5947		CAP-FXD 1000 pF 50 V	04222	08055C102KAT A
C1020-1021	0160-5945		CAP-FXD 0.01 uF 50 V	04222	08055C103KAT A
C1051-C1052	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C1053	0180-4086		CAP-FXD .01 F+-20% 25 VDC	S4217	SME25VN103M22X45LL
C1054	0180-4116		CAP-FXD 22 uF 20 V TA	04222	TAJD226M020
C1055	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
CR301	1906-0291	8	DIODE- 70V 100MA	04713	MBAV99
CR302-CR303	1902-1541	3	DIODE-ZNR 3.3V 5% TO-236 (SOT-23)	04713	BZX84C3V3
CR401	1902-1541		DIODE-ZNR 3.3V 5% TO-236 (SOT-23)	04713	BZX84C3V3
CR601	1906-0291		DIODE- 70V 100MA	04713	MBAV99
CR701-CR702	1902-1512	2	DIODE-ZNR 7.5V 5% PD=.155W TC=+5.3MV	04713	BZX84C7V5
CR703-CR704	1902-1610	4	DIODE-ZNR SMB 3.3V 5% 1W	04713	1SMB5913B
CR709-CR710	1902-1610		DIODE-ZNR SMB 3.3V 5% 1W	04713	1SMB5913B
CR801-CR802	1901-1386	2	DIODE SI PN SOT23 100V 750MA	28480	1901-1386
CR803-CR804	1902-1807	2	DIODE-ZNR SMB 24V 42MA 1.0W 5%	04713	1SMB5934BT3
CR901-CR904	1906-0291	8	DIODE- 70V 100MA	04713	MBAV99
CR1001	1906-0407	2	DIODE-FW BRDG 400V 1A	71744	DF04S
CR1002-1003	1906-0291		DIODE- 70V 100MA	04713	MBAV99
CR1004-1005	1902-1609	3	DIODE-ZNR 6.2V 5% PD=1.5W IR=5UA	04713	1SMB5920B
CR1006-1009	1901-1607	4	DIODE-PWR RECT SMC 400V 2.5A 2.5US S3G	71744	S3G
CR1010	1902-1609		DIODE-ZNR 6.2V 5% PD=1.5W IR=5UA	04713	1SMB5920B
CR1051	1906-0407		DIODE-FW BRDG 400V 1A	71744	DF04S
CR1052	1901-1346	1	DIODE,TVS,D0214AB,43V,1500WP,SMCJ43CA	71744	SMCJ43CA
E901	9164-0173	1	BEEPER	51406	PKM24-4AO-1
F801	2110-0716	1	FUSE-SUBMINIATURE .50A 125V NTD AX UL	75915	R251.500T1
FB401-FB402	9170-1421	7	BEAD, SHIELDING (CHOKE)	28480	9170-1421
FB601	9170-1421		BEAD, SHIELDING (CHOKE)	28480	9170-1421
FB701-FB702	9170-1421		BEAD, SHIELDING (CHOKE)	28480	9170-1421
FB1001-1002	9170-1421		BEAD, SHIELDING (CHOKE)	28480	9170-1421
HS1001-1004	1205-0880	4	HEATSINK-TO-220	13103	7021B-TC10-MT
HSQ713	1205-0213	2	HEAT SINK SGL TO-5/TO-39-CS	13103	2228B
HSQ718	1205-0213		HEAT SINK SGL TO-5/TO-39-CS	13103	2228B
J101	1252-4484	1	CONN-POST TYPE 2.0-PIN-SPCG 12-CONT	27264	52007-1210
J102	1252-4683	1	CONN-FRCC VERT MALE 10PIN SMC	76381	N3662-6202
J301	1250-1884	2	CONNECTOR-RF BNC RCPT, 50-OHM	00779	227161-6
J401	1250-0257	1	CONNECTOR-RF SMB PLUG 50-OHM	00779	413990-3
J601	1251-2969	2	CONN PHONE VERT	27264	15-24-0503
J701	1251-5066	2	CONN DIS VERT MALE 2PIN FP	27264	22-04-1021
J801	1251-2969		CONN PHONE VERT	27264	15-24-0503
J901	1252-2266	1	CONN-RECT D-SUBMIN 9-CKT 9-CONT	00779	748959-1
J902	1252-2161	1	CONN-RECT MICRORBN 24-CKT 24-CONT	00779	554923-2
J903	1250-1884		CONN-RF BNC RCPT PC-W-STDFS 50-OHM	00779	227161-6
J1001	1252-5136	1	CONN-DIS FRIC LOCK VERT MALE 9PIN	27264	26-64-4090
J1002	1251-5066		CONN DIS VERT MALE 2 PIN FP	27264	22-04-1021
J1051	1252-4487	1	CONN-POST TYPE .156-PIN-SPCG 3-CONT	27264	26-64-4030

Reference Designator	Agilent Part Number	Qty	Part Description	Mfr. Code	Mfr. Part Number
JM1001-1004	0699-1503	7	RESISTOR .05 +-100% TKF	28480	0699-1503
JM1051	0699-1503		RESISTOR .05 +-100% TKF	28480	0699-1503
K501-K502	0490-1664	8	RELAY 2C 5VDC-COIL 1A 110VDC	28480	0490-1664
K601-K602	0490-1664		RELAY 2C 5VDC-COIL 1A 110VDC	28480	0490-1664
K801-K804	0490-1664		RELAY 2C 5VDC-COIL 1A 110VDC	28480	0490-1664
L501-L502	9140-1716	2	INDUCTOR 910 nH +2% -2%	02113	1008CS-911XGBC
L503-L504	9140-1102	8	INDUCTOR 560 nH +-5% 2.8W-MMX3.4LG-MM	24226	03273
L505-L506	9140-1425	2	INDUCTOR SMT 270 nH 5%	24226	SM3-270J
L521-L522	9140-1102		INDUCTOR 560 nH +-5% 2.8W-MMX3.4LG-MM	24226	03273
L531-L532	9140-1103	2	INDUCTOR 680 nH +-5% 2.8W-MMX3.4LG-MM	24226	03273
L533-L534	9140-1102		INDUCTOR 560 nH +-5% 2.8W-MMX3.4LG-MM	24226	03273
L535-L536	9140-1101	2	INDUCTOR 470 nH +-5% 2.8W-MMX3.4LG-MM	24226	03273
L537-L538	9140-1102		INDUCTOR 560 nH +-5% 2.8W-MMX3.4LG-MM	24226	03273
L601-L602	0699-1503		RESISTOR .05 +-100% TKF	28480	0600-1503
L801	9140-1099	1	INDUCTOR SMT 220 nH 5%	09021	KL32TER22J
Q401	1854-1037	4	TRANSISTOR PD=350 MW FT=300 MHZ	04713	MMBT3904
Q601-Q602	1854-1037		TRANSISTOR PD=350 MW FT=300 MHZ	04713	MMBT3904
Q603-Q604	1853-0516	4	TRANSISTOR PD=350 MW FT=600 MHZ	04713	MMBTH81
Q605	1853-0567	2	TRANSISTOR PD=350 MW FT=250 MHZ	04713	MMBT3906
Q701	1854-1148	2	TRANSISTOR PD=350 MW FT=650 MHZ	04713	MMBTH10
Q702	1853-0516		TRANSISTOR PD=350 MW FT=600 MHZ	04713	MMBTH81
Q704	1854-1148		TRANSISTOR PD=350 MW FT=650 MHZ	04713	MMBTH10
Q705	1853-0567		TRANSISTOR PD=350 MW FT=250 MHZ	04713	MMBT3906
Q707	1853-0516		TRANSISTOR PD=350 MW FT=600 MHZ	04713	MMBTH81
Q708	1854-1037		TRANSISTOR PD=350 MW FT=300 MHZ	04713	MMBT3904
Q709	1854-1445	1	TRANSISTOR NPN SI SC-59	28480	1854-1445
Q710	5063-1420	1	TRANSISTOR PNP 600 MHZ	28480	5063-1420
Q711-Q712	1853-0728	3	TRANSISTOR PNP SI TO-261AA (SOT-223)	28480	1853-0728
Q713	1854-0597	1	TRANSISTOR NPN 2N5943 SI TO-39 PD=1W	04713	2N5943
Q714	1853-0728		TRANSISTOR PNP SI TO-261AA (SOT-223)	28480	1853-0728
Q715-Q717	1854-1303	3	TRANSISTOR NPN SI TO-261AA (SOT-223)	28480	1854-1303
Q718	1853-0293		TRANSISTOR P RF TO39 30V 500 MA 1GHZ	04713	2N5583
R101-R104	0699-1318	20	RESISTOR 1K +-1% .125 W TKF TC=0+-100	28480	0699-1318
R106-R109	0699-1423	12	RESISTOR 215 +-1% .125 W TKF TC=0+-100	28480	0699-1423
R110	0699-1386	1	RESISTOR 5.62K +-1% .125 W TKF TC=0+-100	28480	0699-1386
R111-R112	0699-1318		RESISTOR 1K +-1% .125 W TKF TC=0+-100	28480	0699-1318
R114-R116	0699-1391	11	RESISTOR 10K +-1% .125 W TKF TC=0+-100	28480	0699-1391
R117	0699-1423		RESISTOR 215 +-1% .125 W TKF TC=0+-100	28480	0699-1423
R118-R119	0699-1318		RESISTOR 1K +-1% .125 W TKF TC=0+-100	28480	0699-1318
R120-R121	0699-1423		RESISTOR 215 +-1% .125 W TKF TC=0+-100	28480	0699-1423
R201	0699-1318		RESISTOR 1K +-1% .125 W TKF TC=0+-100	28480	0699-1318
R203	0699-1391		RESISTOR 10K +-1% .125 W TKF TC=0+-100	28480	0699-1391
R205	0699-3034	1	RESISTOR 1K +-1% .1W TKF TC=0+-100	2M627	MCR10-FZHM-F-1001

Reference Designator	Agilent Part Number	Qty	Part Description	Mfr. Code	Mfr. Part Number
R301	0699-1403	1	RESISTOR 31.6K +-1% .125 W TKF TC=0+-100	28480	0699-1403
R302	0699-3211	2	RESISTOR 39.2K 1% 1206 .125 W 200V TC=100	28480	0699-3211
R303-R304	0699-1318		RESISTOR 1K +-1% .125 W TKF TC=0+-100	28480	0699-1318
R305	0699-1391		RESISTOR 10K +-1% .125 W TKF TC=0+-100	28480	0699-1391
R307-R308	0699-3431	6	RESISTOR 4.99K +-1% .125 W TKF TC=0+-100	28480	0699-3431
R309	0699-1937	1	RESISTOR 1.24K 1% 1206 .125 W TC=100 200V	28480	0699-1937
R310	0699-1384	6	RESISTOR 4.64K +-1% .125 W TKF TC=0+-100	28480	0699-1384
R311	0699-1344	4	RESISTOR 10 +-1% .125 W TKF TC=0+-100	28480	0699-1344
R313-R314	0699-1434	2	RESISTOR 619 +-1% .125 W TKF TC=0+-100	28480	0699-1434
R316	0699-1391		RESISTOR 10K +-1% .125 W TKF TC=0+-100	28480	0699-1391
R317	0699-1374	2	RESISTOR 1.78K +-1% .125 W TKF TC=0+-100	28480	0699-1374
R318-R320	0699-3431		RESISTOR 4.99K +-1% .125 W TKF TC=0+-100	28480	0699-3431
R321	0699-1318		RESISTOR 1K +-1% .125 W TKF TC=0+-100	28480	0699-1318
R322	0699-3211		RESISTOR 39.2K 1% 1206 .125 W 200V TC=100	28480	0699-3211
R323	0699-1400	1	RESISTOR 26.1K +-1% .125 W TKF TC=0+-100	28480	0699-1400
R324	0699-1432	8	RESISTOR 511 +-1% .125 W TKF TC=0+-100	28480	0699-1432
R401	0699-1344		RESISTOR 10 +-1% .125 W TKF TC=0+-100	28480	0699-1344
R402	0699-3698	1	RESISTOR 10 +-1% .1W TKF TC=0+-100	2M627	MCR10-F-10R0
R404	0699-3041	1	RESISTOR 3.48K +-1% .1W TKF TC=0+-100	2M627	MCR10-F-3481
R405-R406	0699-2889	2	RESISTOR 4.7 +-5% .125 W TKF	2M627	MCR18J4R
R407-R408	0699-2832	2	RESISTOR 200 +-0.1% .125 W TF TC=0+-25	11502	W1206R032000BT
R409	0699-1381	1	RESISTOR 3.48K +-1% .125W TKF TC=0+-100	2M627	MCR18-F-3481
R410	0699-2489	3	RESISTOR 10K +-0.1% .125 W TF TC=0+-25	11502	W1206R031002BT
R411	0699-1415	19	RESISTOR 100 +-1% .125 W TKF TC=0+-100	28480	0699-1415
R412	0699-2937	1	RESISTOR 16K +-0.1% .125W TF TC=0+-25	09021	RN73E2BTE1602B
R413	0699-2431	1	RESISTOR 3.32K +-1% .125 W TKF TC=0+-100	28480	0699-2431
R414	0699-1318		RESISTOR 1K +-1% .125 W TKF TC=0+-100	28480	0699-1318
R415	0699-1391		RESISTOR 10K +-1% .125 W TKF TC=0+-100	28480	0699-1391
R418	0699-3594	1	RESISTOR 20.5K +-0.1% .125W TF TC=0+-25	11502	W1206R03-2052B
R420	0699-2103	2	RESISTOR 49.9 +-1% .125 W TKF TC=0+-100	28480	0699-2103
R421	0699-3431		RESISTOR 4.99K +-1% .125 W TKF TC=0+-100	28480	0699-3431
R422	0699-1423		RESISTOR 215 +-1% .125 W TKF TC=0+-100	28480	0699-1423
R423	0699-1431	1	RESISTOR 464 +-1% .125 W TKF TC=0+-100	28480	0699-1431
R424	0699-1318		RESISTOR 1K +-1% .125 W TKF TC=0+-100	28480	0699-1318
R501-R502	0699-3763	10	RESISTOR 69 .1% 1206 .125 W 100V TC=25	11502	W1206-R03-69R0-B
R521-R522	0699-2488	10	RESISTOR 100 +-0.1% .125 W TF TC=0+-25	11502	W1206R031000BT
R601	0699-1433	3	RESISTOR 562 +-1% .125 W TKF TC=0+-100	28480	0699-1433
R602-R609	0699-1345	15	RESISTOR 11 +-1% .125 W TKF TC=0+-100	28480	0699-1345
R610	0699-1826	2	RESISTOR 45.3 +-1% .125 W TKF TC=0+-100	28480	0699-1826
R611-R614	0699-1415		RESISTOR 100 +-1% .125 W TKF TC=0+-100	28480	0699-1415
R615	0699-1433		RESISTOR 562 +-1% .125 W TKF TC=0+-100	28480	0699-1433
R616-R622	0699-1345		RESISTOR 11 +-1% .125 W TKF TC=0+-100	28480	0699-1345
R623	0699-1826		RESISTOR 45.3 +-1% .125 W TKF TC=0+-100	28480	0699-1826
R624-R625	0699-1415		RESISTOR 100 +-1% .125 W TKF TC=0+-100	28480	0699-1415
R626	0699-2712	2	RESISTOR 255 +-1% .125 W TKF TC=0+-100	28480	0699-2712
R627-R628	0699-1415		RESISTOR 100 +-1% .125 W TKF TC=0+-100	28480	0699-1415

Reference Designator	Agilent Part Number	Qty	Part Description	Mfr. Code	Mfr. Part Number
R629	0699-2712		RESISTOR 255 +-1% .125 W TKF TC=0+-100	28480	0699-2712
R630	0699-1415		RESISTOR 100 +-1% .125 W TKF TC=0+-10	28480	0699-1415
R631	0699-1432		RESISTOR 511 +-1% .125 W TKF TC=0+-100	28480	0699-1432
R632-R633	0699-1384		RESISTOR 4.64K +-1% .125 W TKF TC=0+-100	28480	0699-1384
R634	0699-1415		RESISTOR 100 +-1% .125 W TKF TC=0+-10	28480	0699-1415
R635	0699-1432		RESISTOR 511 +-1% .125 W TKF TC=0+-100	28480	0699-1432
R636-R637	0699-1384		RESISTOR 4.64K +-1% .125 W TKF TC=0+-100	28480	0699-1384
R638-R639	0699-1344		RESISTOR 10 +-1% .125 W TKF TC=0+-100	28480	0699-1344
R640	0699-1432		RESISTOR 511 +-1% .125 W TKF TC=0+-100	28480	0699-1432
R641	0699-2631	4	RESISTOR 2K +-1% .125 W TKF TC=0+-100	28480	0699-2631
R642	0699-1432		RESISTOR 511 +-1% .125 W TKF TC=0+-100	28480	0699-1432
R643	0699-2196	1	RESISTOR 78.7 1% 1206 .125 W 200 V TC=100	28480	0699-2196
R644	0699-1415		RESISTOR 100 +-1% .125 W TKF TC=0+-100	28480	0699-1415
R645	0699-1432		RESISTOR 511 +-1% .125 W TKF TC=0+-100	28480	0699-1432
R646	0699-1352	1	RESISTOR 21.5 +-1% .125 W TKF TC=0+-100	28480	0699-1352
R647-R648	0699-1332	2	RESISTOR 196K +-1% .125 W TKF TC=0+-100	28480	0699-1332
R649	0699-1392	2	RESISTOR 11K +-1% .125W TKF TC=0+-100	28480	0699-1392
R650	0699-1330	3	RESISTOR 100K +-1% .125 W TKF TC=0+-100	28480	0699-1330
R651	0699-1392		RESISTOR 11K +-1% .125 W TKF TC=0+-100	28480	0699-1392
R652	0699-1318		RESISTOR 1K +-1% .125 W TKF TC=0+-100	28480	0699-1318
R653	0699-2103		RESISTOR 49.9 +-1% .125 W TKF TC=0+-100	28480	0699-2103
R654	0699-1432		RESISTOR 511 +-1% .125 W TKF TC=0+-100	28480	0699-1432
R655	0699-2631		RESISTOR 2K +-1% .125 W TKF TC=0+-100	28480	0699-2631
R656	0699-1415		RESISTOR 100 +-1% .125 W TKF TC=0+-100	28480	0699-1415
R657	0699-1366	3	RESISTOR 82.5 +-1% .125 W TKF TC=0+-100	28480	0699-1366
R658	0699-1360	1	RESISTOR 46.4 +-1% .125 W TKF TC=0+-100	28480	0699-1360
R659	0699-1432		RESISTOR 511 +-1% .125 W TKF TC=0+-100	28480	0699-1432
R660	0699-1318		RESISTOR 1K +-1% .125 W TKF TC=0+-100	28480	0699-1318
R661	0699-1398	2	RESISTOR 21.5K +-1% .125 W TKF TC=0+-100	28480	0699-1398
R662	0699-1330		RESISTOR 100K +-1% .125 W TKF TC=0+-100	28480	0699-1330
R663	0699-1421	2	RESISTOR 178 +-1% .125 W TKF TC=0+-100	28480	0699-1421
R664	0699-2883	3	RESISTOR 1.4K 1% 1206 .125 W 200V TC=100	28480	0699-2883
R701-R702	0699-2843	2	RESISTOR 100K +-0.1% .125 W TF TC=0+-25	11502	W1206R031003BT
R703-R704	0699-2489		RESISTOR 10K +-0.1% .125 W TF TC=0+-25	11502	W1206R031002BT
R705-R706	0699-2631		RESISTOR 2K +-1% .125 W TKF TC=0+-100	28480	0699-2631
R707-R708	0699-1422	2	RESISTOR 196 +-1% .125 W TKF TC=0+-100	28480	0699-1422
R710	2100-4199	1	RESISTOR-TRMR 100 20% TKF TOP-ADJ 1-TRN	32997	3314G-1-101E
R711	0699-2883		RESISTOR 1.4K 1% 1206 .125 W 200V TC=100	28480	0699-2883
R712	0699-1394	1	RESISTOR 14.7K +-1% .125 W TKF TC=0+-100	28480	0699-1394
R713	0699-1366		RESISTOR 82.5 +-1% .125 W TKF TC=0+-100	28480	0699-1366
R715-R716	0699-1415		RESISTOR 100 +-1% .125 W TKF TC=0+-100	28480	0699-1415
R717	0699-2883		RESISTOR 1.4K 1% 1206 .125 W 200V TC=100	28480	0699-2883
R718	0699-1351	2	RESISTOR 19.6 +-1% .125 W TKF TC=0+-100	28480	0699-1351
R719-R720	0699-1415		RESISTOR 100 +-1% .125 W TKF TC=0+-100	28480	0699-1415
R722	0699-1366		RESISTOR 82.5 +-1% .125 W TKF TC=0+-100	28480	0699-1366
R723	0699-1351		RESISTOR 19.6 +-1% .125 W TKF TC=0+-100	28480	0699-1351

Reference Designator	Agilent Part Number	Qty	Part Description	Mfr. Code	Mfr. Part Number
R724	0699-1437	4	RESISTOR 825 +-1% .125 W TKF TC=0+-100	28480	0699-1437
R725	0699-1415		RESISTOR 100 +-1% .125 W TKF TC=0+-100	28480	0699-1415
R726-R727	0699-2064	2	RESISTOR 6.8 +-5% .125 W TKF TC=0+-500	2M627	MCR18J
R728	0699-1415		RESISTOR 100 +-1% .125 W TKF TC=0+-100	28480	0699-1415
R729-R730	0699-1827	2	RESISTOR 130 1% 1206PKG TC=100 200V 1/8W	28480	0699-1827
R731-R732	0699-2890	4	RESISTOR 3.3 5% 1206 .125 W 200V TC=500	2M627	MCR18EZHJ3R3E
R734-R735	0699-2890		RESISTOR 3.3 5% 1206 .125 W 200V TC=500	2M627	MCR18EZHJ3R3E
R738	0699-1378	1	RESISTOR 2.61K +-1% .125 W TKF TC=0+-100	28480	0699-1378
R739	0699-1387	3	RESISTOR 6.81K +-1% .125 W TKF TC=0+-100	28480	0699-1387
R740	0699-1426	1	RESISTOR 287 +-1% .125 W TKF TC=0+-100	28480	0699-1426
R741	0699-1437		RESISTOR 825 +-1% .125 W TKF TC=0+-100	28480	0699-1437
R744-R747	0699-2488		RESISTOR 100 +-0.1% .125 W TF TC=0+-25	11502	W1206R031000BT
R748-R749	0699-1437		RESISTOR 825 +-1% .125 W TKF TC=0+-100	28480	0699-1437
R750-R751	0699-1387		RESISTOR 6.81K +-1% .125 W TKF TC=0+-100	28480	0699-1387
R752-R755	0699-2488		RESISTOR 100 +-0.1% .125 W TF TC=0+-25	11502	W1206R031000BT
R756	0699-3019	14	RESISTOR 26.1 1% SM0805 .1 W TC=250 100V	28480	0699-3019
R758	0699-3019		RESISTOR 26.1 1% SM0805 .1 W TC=250 100V	28480	0699-3019
R760-R764	0699-3019		RESISTOR 26.1 1% SM0805 .1 W TC=250 100V	28480	0699-3019
R766-R772	0699-3019		RESISTOR 26.1 1% SM0805 .1 W TC=250 100V	28480	0699-3019
R774-R775	0699-3022	2	RESISTOR 46.4 +-1% .1 W TKF TC=0+-200	28480	0699-3022
R801	0699-3769	4	RESISTOR 11.8 +-1% .125 W TKF TC=0+-100	28480	0699-3769
R802-R803	0699-1423		RESISTOR 215 +-1% .125 W TKF TC=0+-100	28480	0699-1423
R804-R806	0699-3770	4	RESISTOR 23.7 +-0.1% .125 W TF TC=0+-25	11502	W1206-R03-23R7-B
R807-R808	0699-3765	4	RESISTOR 115 .1% 1206 .125 W 100V TC=25	11502	W1206-R03-1150-B
R809	0699-3762	4	RESISTOR 53 .1% 1206 .125 W 100V TC=25	11502	W1206-R03-53R0-B
R810-R811	0699-3766	2	RESISTOR 232 .1% 1206 .125 W 100V TC=25	11502	W1206-R03-2320-B
R812-R813	0699-3763		RESISTOR 69 .1% 1206 .125 W 100V TC=25	11502	W1206-R03-69R0-B
R814	0699-3767	2	RESISTOR 309 .1% 1206 .125 W 100V TC=25	11502	W1206-R03-3090-B
R815	0699-3763		RESISTOR 69 .1% 1206 .125 W 100V TC=25	11502	W1206-R03-69R0-B
R816-R817	0699-1423		RESISTOR 215 +-1% .125 W TKF TC=0+-100	28480	0699-1423
R818	0699-2852	2	RESISTOR 442 +-1% .125 W TKF TC=0+-100	28480	0699-2852
R819	0699-3770		RESISTOR 23.7 +-0.1% .125 W TF TC=0+-25	11502	W1206-R03-23R7-B
R820	0699-2852		RESISTOR 442 +-1% .125 W TKF TC=0+-100	28480	0699-2852
R821	0699-3769		RESISTOR 11.8 +-1% .125 W TKF TC=0+-100	28480	0699-3769
R822-R823	0699-3764	2	RESISTOR 442 0.1% 1206 .125W 100V TC=25	11502	W1206-R03-4420-B
R824-R825	0699-3765		RESISTOR 115 .1% 1206 .125W 100V TC=25	11502	W1206-R03-1150-B
R826-R827	0699-3763		RESISTOR 69 .1% 1206 .125 W 100V TC=25	11502	W1206-R03-69R0-B
R828-R829	0699-3769		RESISTOR 11.8 +-1% .125 W TKF TC=0+-100	28480	0699-3769
R830-R832	0699-3762		RESISTOR 53 .1% 1206 .125 W 100V TC=25	11502	W1206-R03-53R0-B
R833	0699-3767		RESISTOR 309 .1% 1206 .125 W 100V TC=25	11502	W1206-R03-3090-B
R834-R836	0699-3763		RESISTOR 69 .1% 1206 .125 W 100V TC=25	11502	W1206-R03-69R0-B
R837	0699-1383	1	RESISTOR 4.22K +-1% .125 W TKF TC=0+-100	28480	0699-1383
R901	0699-1318		RESISTOR 1K +-1% .125 W TKF TC=0+-100	28480	0699-1318
R902	0699-1330		RESISTOR 100K +-1% .125 W TKF TC=0+-100	28480	0699-1330
R904-R905	0699-1318		RESISTOR 1K +-1% .125 W TKF TC=0+-100	28480	0699-1318
R906	0699-1374		RESISTOR 1.78K +-1% .125 W TKF TC=0+-100	28480	0699-1374
R907	0699-1398		RESISTOR 21.5K +-1% .125 W TKF TC=0+-100	28480	0699-1398

Reference Designator	Agilent Part Number	Qty	Part Description	Mfr. Code	Mfr. Part Number
R908	0699-1318		RESISTOR 1K +-1% .125 W TKF TC=0+-100	28480	0699-1318
R909	0699-3408	1	RESISTOR 1K +-5% 1 W TKF TC=0+-200	2M627	MCR1001KJ
R910	0699-1391		RESISTOR 10K +-1% .125 W TKF TC=0+-100	28480	0699-1391
R1001	0699-1380	3	RESISTOR 3.16K +-1% .125 W TKF TC=0+-100	28480	0699-1380
R1002	0699-1424	2	RESISTOR 237 +-1% .125 W TKF TC=0+-100	28480	0699-1424
R1003	0699-1380		RESISTOR 3.16K +-1% .125 W TKF TC=0+-100	28480	0699-1380
R1004	0699-1424		RESISTOR 237 +-1% .125 W TKF TC=0+-100	28480	0699-1424
R1008-R1009	0699-1391		RESISTOR 10K +-1% .125 W TKF TC=0+-100	28480	0699-1391
R1010	0699-1421		RESISTOR 178 +-1% .125 W TKF TC=0+-100	28480	0699-1421
R1011	0699-1433		RESISTOR 562 +-1% .125W TKF TC=0+-100	28480	0699-1433
R1012	0699-1391		RESISTOR 10K +-1% .125 W TKF TC=0+-100	28480	0699-1391
R1013	0699-1380		RESISTOR 3.16K +-1% .125 W TKF TC=0+-100	28480	0699-1380
R1014	0699-1384		RESISTOR 4.64K +-1% .125 W TKF TC=0+-100	28480	0699-1384
R1052	0699-1327	1	RESISTOR 1M +-1% .125 W TKF TC=0+-100	28480	0699-1327
RP301-RP302	1810-1360	2	RESISTOR-NETWORK 16PINS,THICK FILM,SMD	28480	1810-1360
RP401	1810-1065	1	NET-RES 15 1.0K OHM 16-PIN	11236	767161102G
RP403-RP404	1810-1331	2	NET-RES 8 220.0 OHM 16-PIN	11236	767163221G
RP601	1810-1159	1	RESISTOR-NETWORK	28480	1810-1159
SHD902	33120-00614	1	RFI SHIELD	28480	33120-00614
SPR1-SPR2	0380-0643	2	STANDOFF-HEX .255-IN-LG 6-32-THD	28480	0380-0643
SPR10-SPR20	2190-0577	2	WASHER- NO. 10 .194-IN-ID .294-IN-OD	20859	03118
U101	1990-1552	3	OPTO-ISOLATOR LED-IC GATE IF=10 MA-MAX	28480	HCPL-2211-300
U102	1821-1479	1	IC-BIT SLICE MPU/MCU	34649	N80C196KB
U103	1820-8907	1	IC GATE-ARY CMOS	27014	SCX6206AK0
U104	33120-88861	1	PROG PAL	28480	33120-88861
U105	1818-4777	1	IC 256K-BIT SRAM 70-NS CMOS	28480	1818-4777
U106	1818-5699	1	IC, CMOS, AMB, 32 PIN, 120 NANOSECONDS	34335	AM29F010-120JC
U107	1820-5808	2	IC FF CMOS/74HC D-TYPE POS-EDGE	04713	MC74HC273DW
U108	1820-5941	1	IC DCDR CMOS/74ACT BIN 8-TO-1-LINE	28480	1820-5941
U109	1820-5944	2	74ACT32-GATE, QUAD 2-INPUT OR	28480	1820-5944
U201	1820-6306	3	IC TRANSCEIVER CMOS/HCT BUS OCTL	27014	MM74HCT245WM
U202	1820-5808		IC FF CMOS/74HC D-TYPE POS-EDGE	04713	MC74HC273DW
U203-U204	1820-6306	3	IC TRANSCEIVER CMOS/HCT BUS OCTL	27014	MM74HCT245WM
U205	1818-5093	1	IC 256K-BIT SRAM 25-NS CMOS	04713	MCM6206DJ25
U206	1821-0976	1	IC MODULATOR ANLG 68 PIN PLCC	01295	F107563FN
U210	1820-7244	2	IC SCHMITT-TRIG CMOS/74AC INV HEX	27014	74AC14SC
U211	1820-5940	1	IC GATE CMOS/74ACT AND QUAD 2-INP	28480	1820-5940
U212	1820-5944		74ACT32-GATE, QUAD 2-INPUT OR	07263	02237
U213	1990-1552		OPTO-ISOLATOR LED-IC GATE IF=10MA-MAX	28480	HCPL-2211-300
U214	1820-8830	2	IC MUXR/DATA-SEL CMOS/ACT 8-TO-1-LINE	04713	MC74ACT251D
U215	1820-5937	1	IC FF CMOS/74AC D-TYPE POS-EDGE-TRIG	07263	02237
U216	1820-4998	1	IC GATE TTL/F OR QUAD 2-INP	27014	74F32SC
U217	1820-5943	2	IC MUXR/DATA-SEL CMOS/74ACT 2-TO-1-LINE	07263	02237
U218	1821-0559	1	IC FF BICMOS/ABT D-TYPE POS-EDGE-TRIG	01295	SN74ABT16374ADL

Reference Designator	Agilent Part Number	Qty	Part Description	Mfr. Code	Mfr. Part Number
U301-U302	1821-0964	2	IC DRVR 8X S 20SOL 45V 250MA	01295	TPIC6595DW
U303	1826-2793	1	IC DA VOUT SER 16SOL 16BIT AD1851R	24355	AD1851R
U304	1821-0434	3	IC ANLG-MUXR/DEMUXR CMOS/HC 8-CHAN	18324	74HC4051D
U305	1820-5790	1	IC SHF-RGTR CMOS/74HC SYNCHRO SERIAL-IN	18324	74HC4094D
U306-U307	1826-1622	4	IC OP AMP LOW-BIAS-H-IMPD QUAD 14 PIN	04713	TL074CD
U314	1826-1622		IC OP AMP LOW-BIAS-H-IMPD QUAD 14 PIN	04713	TL074CD
U315	1820-5943		IC MUXR/DATA-SEL CMOS/74ACT 2-TO-1-LINE	07263	02237
U401	1820-6524	1	IC XLTR ECL/10KH TTL-TO-ECL QUAD	04713	MC10H124FN
U402-U403	1820-8461	2	IC FF BICMOS/ABT D-TYPE POS-EDGE-TRIG	01295	SN74ABT574ADW
U404-U405	1818-4983	2	IC 256K-BIT SRAM 15-NS CMOS	28480	1818-4983
U407	1826-3517	1	D/A 12-BIT 28-PLCC MISC	28480	1826-3517
U409	1826-1619	1	D/A 8-BIT 20-PLCC CMOS	24355	AD7528JP
U410	1826-1622		IC OP AMP LOW-BIAS-H-IMPD QUAD 14 PIN	04713	TL074CD
U411	1820-4377	1	IC GATE TTL/F NAND QUAD 2-INP	27014	74F00SC
U412	1820-5732		IC LCH CMOS/74HC D-TYPE OCTL	04713	MC74HC573ADW
U413	1813-0861	1	CLOCK-OSCILLATOR-XTAL 40.000-MHZ 0.01%	28480	1813-0861
U601-U602	1821-0434		IC ANLG-MUXR/DEMUXR CMOS/HC 8-CHAN	18324	74HC4051D
U603	1826-2797	1	IC MULTIPLIER HS 14 PIN DIP-P	24355	AD734AN
U604	1820-8830		IC MUXR/DATA-SEL CMOS/ACT 8-TO-1-LINE	04713	MC74ACT251D
U620	1826-1950	1	IC COMPARATOR HS SGL 8 PIN PLSTC-SOIC	28480	1826-1950
U621	1821-0622	1	IC DRVR BICMOS/ABT LINE OCTL	18324	74ABT540D
U702	1826-1991	1	IC OP AMP HS SINGLE 8 PIN PLSTC-SOIC	24355	AD711JR
U901	1990-1552		OPTO-ISOLATOR LED-IC GATE IF=10MA-MAX	28480	HCPL-2211-300
U902	1820-7244		IC SCHMITT-TRIG CMOS/74AC INV HEX	27014	74AC14SC
U903	34401-88842	1	IC, ROM PROGRAMMED	28480	34401-88842
U904	1821-1721	1	IC GPIB CONTROLLER	01295	MP9914FNL
U906	1820-7662	1	IC-INTERFACE DRVR/RCVR BIPOLAR DUAL	28480	1820-7662
U907	1820-6176	1	IC-INTERFACE XCVR BIPOLAR BUS OCTL	01295	SN75ALS160DW
U908	1820-6175	1	IC-INTERFACE XCVR BIPOLAR BUS OCTL	01295	SN75ALS162DW
U1001	1826-0527	2	IC V RGLTR-ADJ-NEG 1.2/37V 3-TO-220 PKG	27014	LM337T
U1002	1826-0393	1	IC V RGLTR-ADJ-POS 1.2/37V 3-TO-220 PKG	27014	LM317
U1003	1826-0527		IC V RGLTR-ADJ-NEG 1.2/37V 3-TO-220 PKG	27014	LM337T
U1004	1826-1597	1	IC V RGLTR-FXD-POS 4.85/5.15V TO-220 PKG	27014	LM2940CT
U1006	1826-2264	2	IC PWR MGT-UND-V-SEN 8 PINS P-SOIC PKG	04713	MC34064D-5
U1007	1826-2801	1	IC V RGLTR-OV-V-SEN 8-P-SOIC PKG	04713	MC3423D
U1051	1826-2794	1	IC V RGLTR-FXD-POS 4.85/5.15V 3-TO-220	27014	LM2490CT-5.0-LB01
U1052	1826-2264		IC PWR MGT-UND-V-SEN 8 PINS P-SOIC PKG	04713	MC34064D-5
XJ601	3050-0447	2	WASHER-FL NM NO. 8 .192-IN-ID .37-IN-OD	28480	3050-0447
XJ801	3050-0447		WASHER-FL NM NO. 8 .192-IN-ID .37-IN-OD	28480	3050-0447
XQ713	1200-0181	2	INSULATOR-XSTR NYLON	13103	7717-5-N
XQ718	1200-0181		INSULATOR-XSTR NYLON	13103	7717-5-N
Y101	0410-4009	2	CERO-RES 12 MHZ +1-0.8%	28480	0410-4009
Y901	0410-4009		CERO-RES 12 MHZ +1-0.8%	28480	0410-4009

■ 33120-66502 – Display and Keyboard PC Assembly

Reference Designator	Agilent Part Number	Qty	Part Description	Mfr. Code	Mfr. Part Number
C1101	0160-5945	3	CAP-FXD 0.01 uF 50 V	04222	08055C103KAT A
C1102-1103	0180-3751	10	CAP-FXD 1 uF 35 V TA	S0545	NRS105M35R8
C1104	0160-6497	3	CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C1105	0160-5947		CAP-FXD 1000 pF 50 V	04222	08055C102KAT A
C1201-1203	0160-6497		CAP-FXD 0.1 uF 25 V	04222	12065C104KAT A
C1301-1302	0160-5947		CAP-FXD 1000 pF 50 V	04222	08055C102KAT A
C1303-1304	0160-5945		CAP-FXD 0.01 uF 50 V	04222	08055C103KAT A
C1305-1310	0160-6497		CAP-FXD 0.1 uF 25 V A	04222	12065C104KAT A
CR1101	1906-0291	1	DIODE- 70 V 100 MA	04713	MBAV99
CR1102	1906-0395	1	DIO SIG 2X SOT143L 75V 215MA 2PF	25403	BAS28
CR1105	1902-1542	1	DIODE-ZNR 6.2V 5% TO-236 (SOT-23)	04713	BZX84C6V2
J1301	34401-61602	1	DISPLAY CABLE ASSY, 8.8L	28480	34401-61602
L1301	9170-1431	1	SHIELDING CORE, BEADS	28480	9170-1431
M1301	33120-00611	1	SHIELD-ESD	28480	33120-00611
R1101	0699-1399	2	RESISTOR 23.7K +-1% .125W TKF TC=0+-100	2M627	MCR18FX
R1102	0699-1391	4	RESISTOR 10K +-1% .125W TKF TC=0+-100	2M627	MCR18FX
R1103-1106	0699-1344	4	RESISTOR 10 +-1% .125 W TKF TC=0+-100	28480	0699-1344
R1107	0699-1391		RESISTOR 10K +-1% .125W TKF TC=0+-100	2M627	MCR18FX
R1108	0699-1378	1	RESISTOR 2.61K +-1% .125W TKF TC=0+-100	2M627	MCR18FX
R1109	0699-1435	1	RESISTOR 681 +-1% .125W TKF TC=0+-100	2M627	MCR18FX
R1301-1304	0699-1423	4	RESISTOR 215 +-1% .125W TKF TC=0+-100	2M627	MCR18FX
R1305-1306	0699-1391		RESISTOR 10K +-1% .125W TKF TC=0+-100	2M627	MCR18FX
R1307-1308	0699-1330	2	RESISTOR 100K +-1% .125W TKF TC=0+-100	2M627	MCR18FX
R1309	0699-1399	1	RESISTOR 23.7K +-1% .125W TKF TC=0+-100	2M627	MCR18FX
S1119	0960-0892		ROTARY ENCODER	28480	0960-0892
U1101	33120-88813	1	87C51 PROG	28480	33120-88813
U1102	1826-1402	1	IC-V RGLTR-FXD-POS 4.8/5.2V 8-P-SOIC PKG	04713	MC78L05ACD
U1103	1826-2264	1	IC-PWR MGT-UND-V-SEN 8 PINS P-SOIC PKG	04713	MC34064D-5
U1201	1820-5562	1	74HC02-GATE, QUAD 2-INPUT NOR INPUT	01295	SN74HC02D
U1202	1820-4966	1	IC-FF CMOS/74HC D-TYPE POS-EDGE-TRIG	01295	SN74HC74D
U1203	1820-5330	1	IC-INTERFACE DRIVER BIPOLAR DISPLAY	01295	SN75518FN
U1204	33120-89301	1	VACUUM FLUORESCENT DISPLAY	28480	33120-89301
U1301	1826-1528	1	IC-COMPARATOR LP QUAD 14 PIN PLSTC-SOIC	27014	LM339M
U1302	1820-6756	1	IC-SHIFT-REGISTER CMOS/74HC BIDIR	04713	MC74HC299D
Y1101	0410-4009	1	CERO-RES 12 MHZ +1-0.8%	28480	0410-4009

33120A Mainframe

Reference Designator	Agilent Part Number	Qty	Part Description	Mfr. Code	Mfr. Part Number
A1	33120-66521	1	MAIN PC ASSEMBLY	28480	33120-66521
A2	33120-66502	1	DISPLAY AND KEYBOARD PC ASSEMBLY	28480	33120-66502
B1	3160-0847	1	FAN-TBAX 12V 5.3-CFM NOM	11855	DFB0412L-SG
CBL1-CBL2	33120-61601	2	CABLE BNC	28480	33120-61601
CBL4	RS232-61601	1	RS-232 CABLE	28480	RS232-61601
CD1	33250-13603	1	AGILENT INTUILINK ARB SOFTWARE CD	28480	33250-13603
CVR1	33120-84131	1	COVER	28480	33120-84131
F1	2110-0458	1	FUSE-500 MAT	75915	239.500
FRM1	33120-80111	1	CHASSIS	28480	33120-80111
HDW1	0380-1820	1	SPACER, .438 IN LG, .280 IN OD	28480	0380-1820
HDW2	0535-0154	1	NUT-HEX SGL-CHAM M9.0 X 0.75 2MM-THK	11239	3-9-03
HDW3	3050-1547	1	WASHER-FL MTLC 9.0 9.2-MM-ID 14-MM-OD AL	11239	4-9-01
HDW4	34401-88304	1	REAR PANEL	28480	34401-88304
KIT1	34401-86010	1	BUMPERS (FRNT/REAR) & POWER MOD CVR	28480	34401-86010
KYC1	33120-87411	1	FRONT-PANEL KNOB	28480	33120-87411
KYC2	34401-43711	1	PUSH-ROD, POWER-ON	28480	34401-43711
KYC3	34401-45011	1	CARRYING HANDLE	28480	33120-45011
MP2	33120-81911	1	FRONT-PANEL KEYPAD	28480	33120-81911
PNL1	33120-40211	1	FRONT-PANEL/BEZEL ASSEMBLY	28480	33120-40211
PS1	33120-86201	1	POWER-MODULE/FUSE & FUSE DRWR	28480	33120-86201
SCR1-SCR7	0515-0433	7	SCREW-M4 X 8MM LG PAN-HD	28480	0515-0433
SCR8-SCR9	0624-0862	2	SCREW-TPG .750-IN-LG PAN-HD-PHL STL,1022	93907	225-44395-890
T1	9100-5090	1	TRANSFORMER-PWR 100/120/220/240V	08807	8470B45
WD1	33120-49321	1	FRONT DISPLAY WINDOW	28480	33120-49321

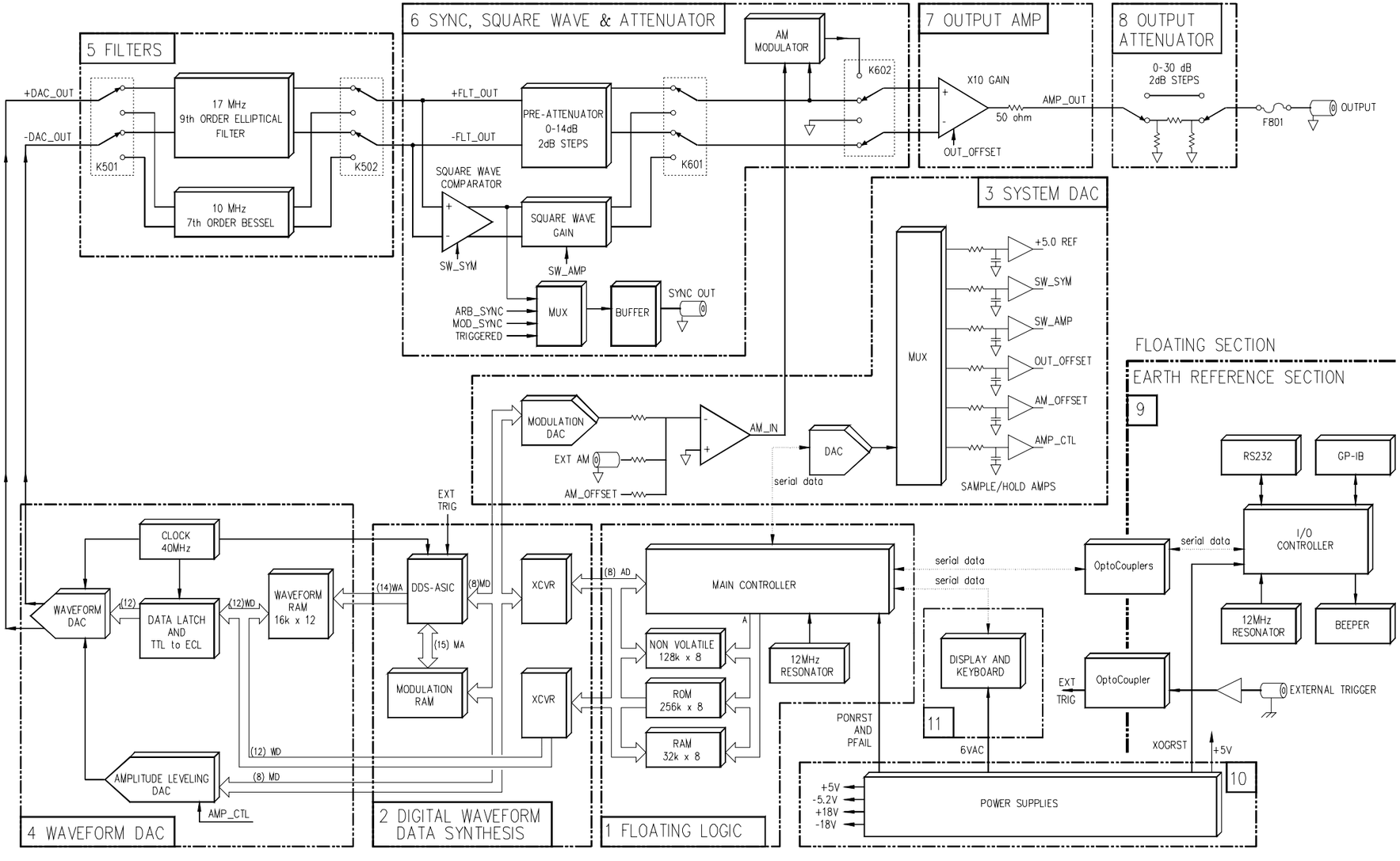
Manufacturer's List

Mfr Code	Manufacturer's Name	Manufacturer's Address	Zip Code
00779	Amp Inc	Harrisburg, PA, U.S.A.	17111
01295	Texas Instruments Inc	Dallas, TX, U.S.A.	75265
02113	Coilcraft Inc	Cary, IL, U.S.A.	60013
04222	AVX Corp	Great Neck, NY, U.S.A.	11021
04713	Motorola Inc	Roselle, IL, U.S.A.	60195
05971	LYN-TRON Inc	Burbank, CA, U.S.A.	91505
07263	Fairchild Semiconductor Corp	Cupertino, CA, U.S.A.	95014
07933	Raytheon Co Semiconductor Div Hq	Mountain View, CA, U.S.A.	94040
08807	MidwestCo Enterprises Inc	Grayslake, IL, U.S.A.	60030
09021	KOA Speer Electronics Inc	Bradford, PA, U.S.A.	16701
11236	CTS Corp	Elkhart, IN, U.S.A.	46514
11239	Nobel Mercantile Co	Alburquerque, NM, U.S.A.	87109
11502	IRC Inc	Corpus Christi, TX, U.S.A.	78411
11855	Delta Electronic Industries Co	Taipei, Taiwan	
13103	Thermalloy Inc	Dallas, TX, U.S.A.	75234
18324	Signetics Corp	Sunnyvale, CA, U.S.A.	94086
20859	Mellowes Co	Milwaukee, WI, U.S.A.	53212
24355	Analog Devices Inc	Norwood, MA, U.S.A.	02062
24444	General Semiconductor Ind Inc	Tempe, AZ, U.S.A.	85281
24226	Gowanda Electronics Corp	Gowanda, NY, U.S.A.	14070
25403	NV Philips Elcoma	Eindhoven, Netherlands	02876
27014	National Semiconductor Corp	Santa Clara, CA, U.S.A.	95052
27264	Molex Inc	Lisle, IL, U.S.A.	60532
28480	Agilent Technologies, Inc.	Palo Alto, CA, U.S.A.	94303
32997	Bourns Networks Inc	Riverside, CA, U.S.A.	92507
34335	Advanced Micro Devices Inc	Sunnyvale, CA, U.S.A.	94086
34649	Intel Corp	Santa Clara, CA, U.S.A.	95054
51406	Murata Corporation Of America	Marietta, GA, U.S.A.	30067
71744	General Instrument Corp	Clifton, NJ, U.S.A.	07012
75915	Littelfuse Inc	Des Plaines, IL, U.S.A.	60016
76381	3M Corp	St. Paul, MN, U.S.A	55144
93907	Camcar Screw and Mfg Co	Rockford, IL, U.S.A.	61101
2L446	ADAC Screw Machine Products	Redwood City, CA, U.S.A.	94063
2M627	Rohm Corp	Kyoto 615, JAPAN	
S0545	NEC Electronics Inc	Mountain View, CA, U.S.A.	94043
S4217	Nippon Chemi-Con Corp	Ohme-shi Tokyo, JAPAN	

Schematics

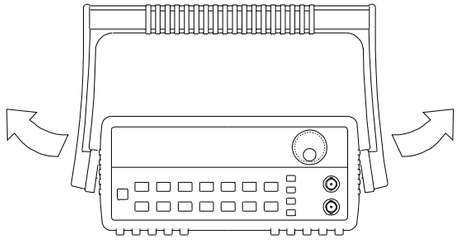
Schematics

You may notice parts labeled as "No Load" on several schematics. These are parts that were included in the original design but were removed later to enhance performance or reduce cost.


5 FILTERS
+DAC_OUT
-DAC_OUT
K501
17 MHz
9th ORDER ELLIPTICAL
FILTER
10 MHz
7th ORDER BESSEL
K502
6 SYNC, SQUARE WAVE & ATTENUATOR
+FLT_OUT
-FLT_OUT
PRE-ATTENUATOR
0-14dB
2dB STEPS
K601
SQUARE WAVE
COMPARATOR
SW_SYM
SQUARE WAVE
GAIN
SW_AMP
ARB_SYNC
MOD_SYNC
TRIGGERED
MUX
BUFFER
SYNC OUT
AM
MODULATOR
K602
7 OUTPUT AMP
X10 GAIN
AMP_OUT
50 ohm
OUT_OFFSET
8 OUTPUT
ATTENUATOR
0-30 dB
2dB STEPS
F801
OUTPUT
3 SYSTEM DAC
MUX
+5.0 REF
SW_SYM
SW_AMP
OUT_OFFSET
AM_OFFSET
AMP_CTL
SAMPLE/HOLD AMPS
FLOATING SECTION
EARTH REFERENCE SECTION
9
MODULATION
DAC
EXT AM
AM_OFFSET
AM_IN
DAC
serial data
EXT
TRIG
CLOCK
40MHz
WAVEFORM
DAC
(12)
DATA LATCH
AND
TTL to ECL
(12)WD
WAVEFORM
RAM
16k x 12
(14)WA
DDS-ASIC
(8)MD
(15) MA
MODULATION
RAM
XCVR
XCVR
(8) AD
MAIN CONTROLLER
A
NON VOLATILE
128k x 8
ROM
256k x 8
RAM
32k x 8
12MHz
RESONATOR
serial data
serial data
OptoCouplers
serial data
I/O
CONTROLLER
RS232
GP-IB
12MHz
RESONATOR
BEEPER
DISPLAY AND
KEYBOARD
11
6VAC
EXT
TRIG
OptoCoupler
EXTERNAL TRIGGER
PONRST
AND
PFAIL
XOGRST
+5V
10
+5V
-5.2V
+18V
-18V
POWER SUPPLIES
(12) WD
(8) MD
AMPLITUDE LEVELING
DAC
AMP_CTL
4 WAVEFORM DAC
2 DIGITAL WAVEFORM
DATA SYNTHESIS
1 FLOATING LOGIC

①

Pull Off Handle



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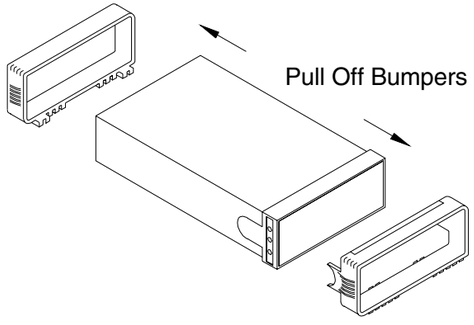

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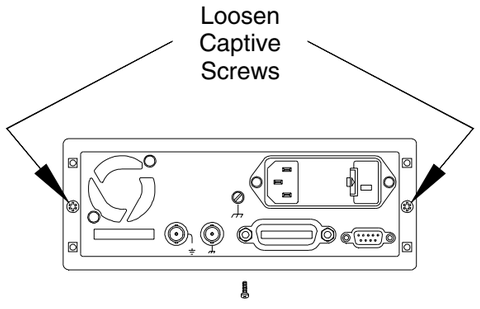

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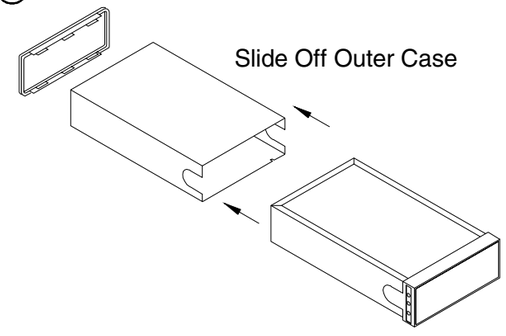

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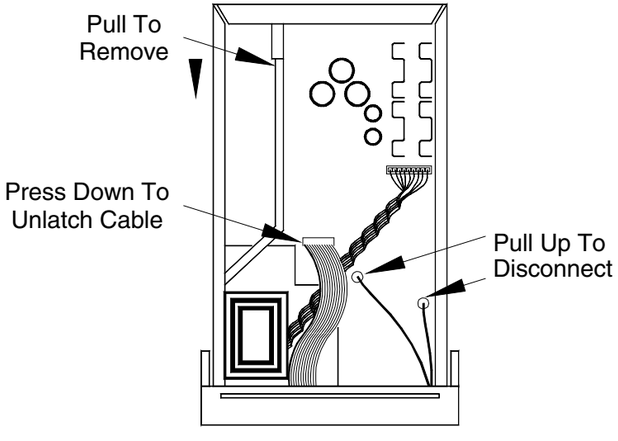

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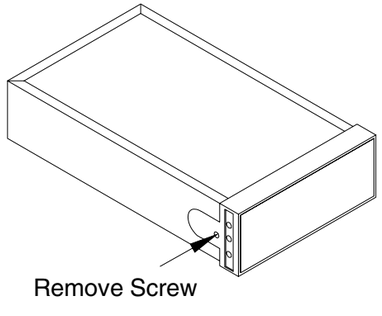

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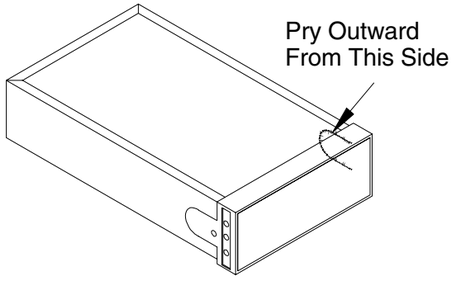

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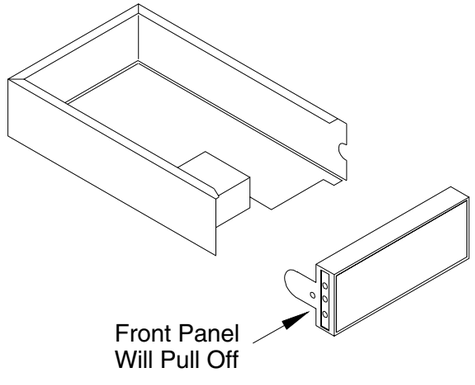
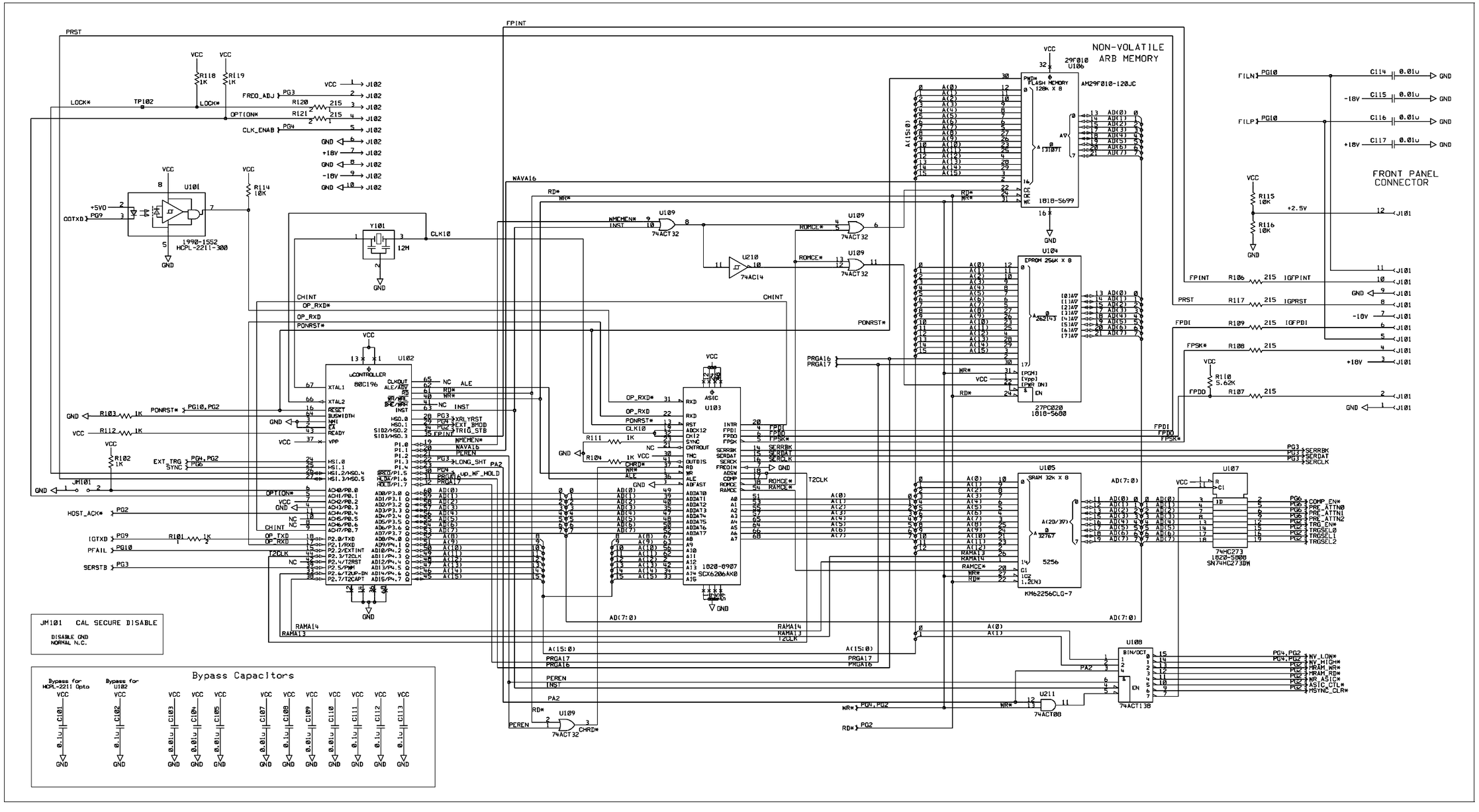
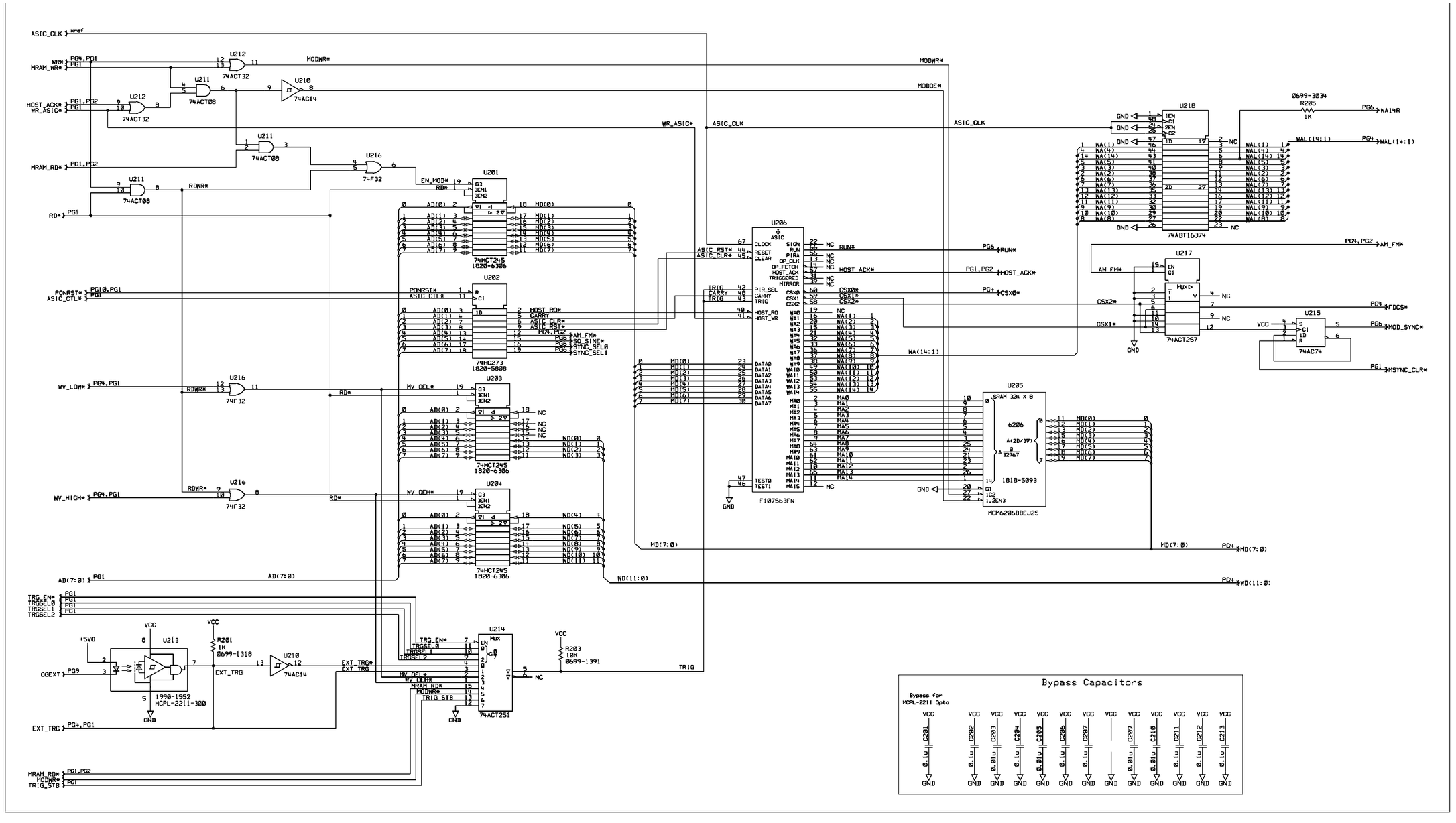
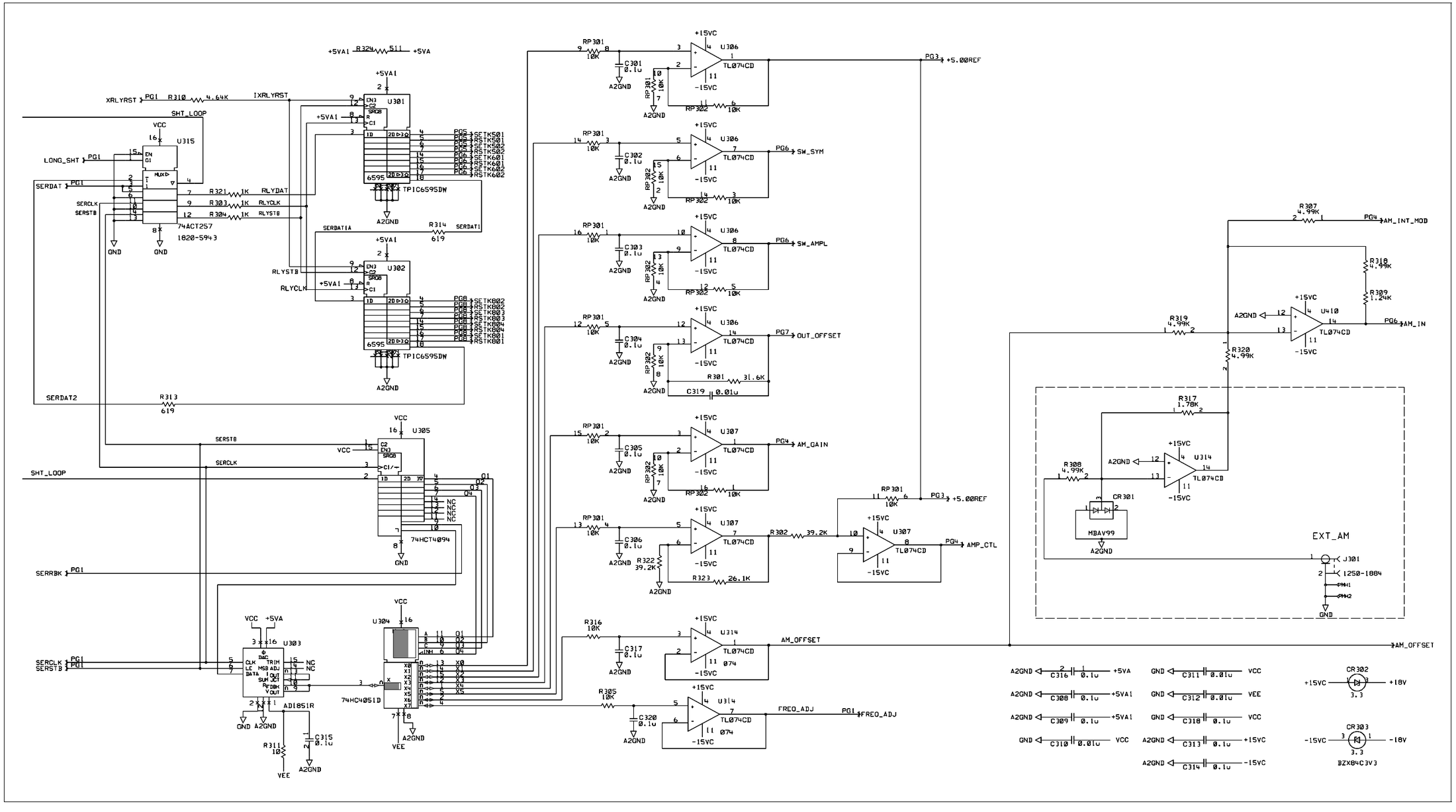


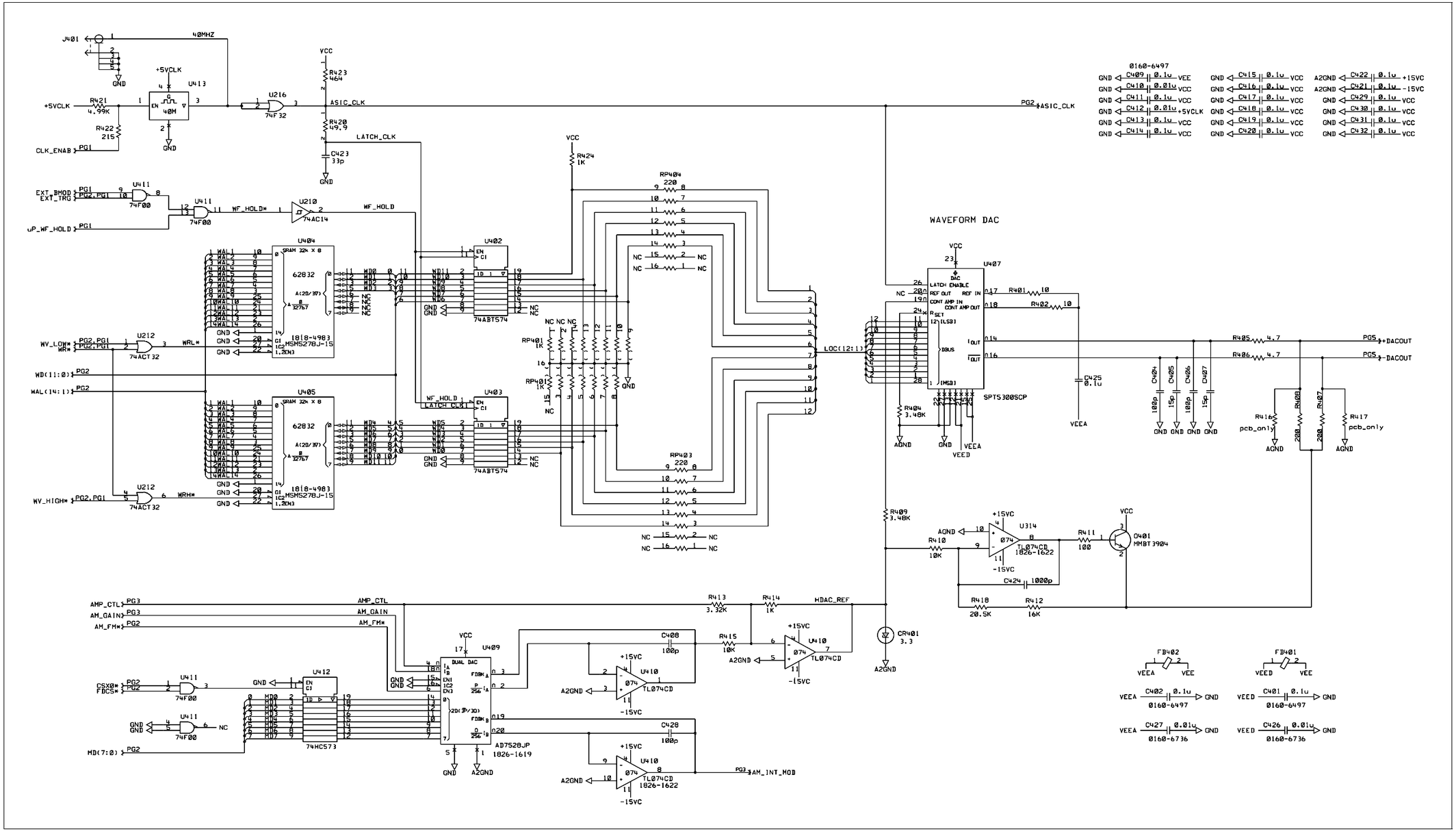


33120-66521 (sheet 1 of 10)
Floating Logic Schematic
131

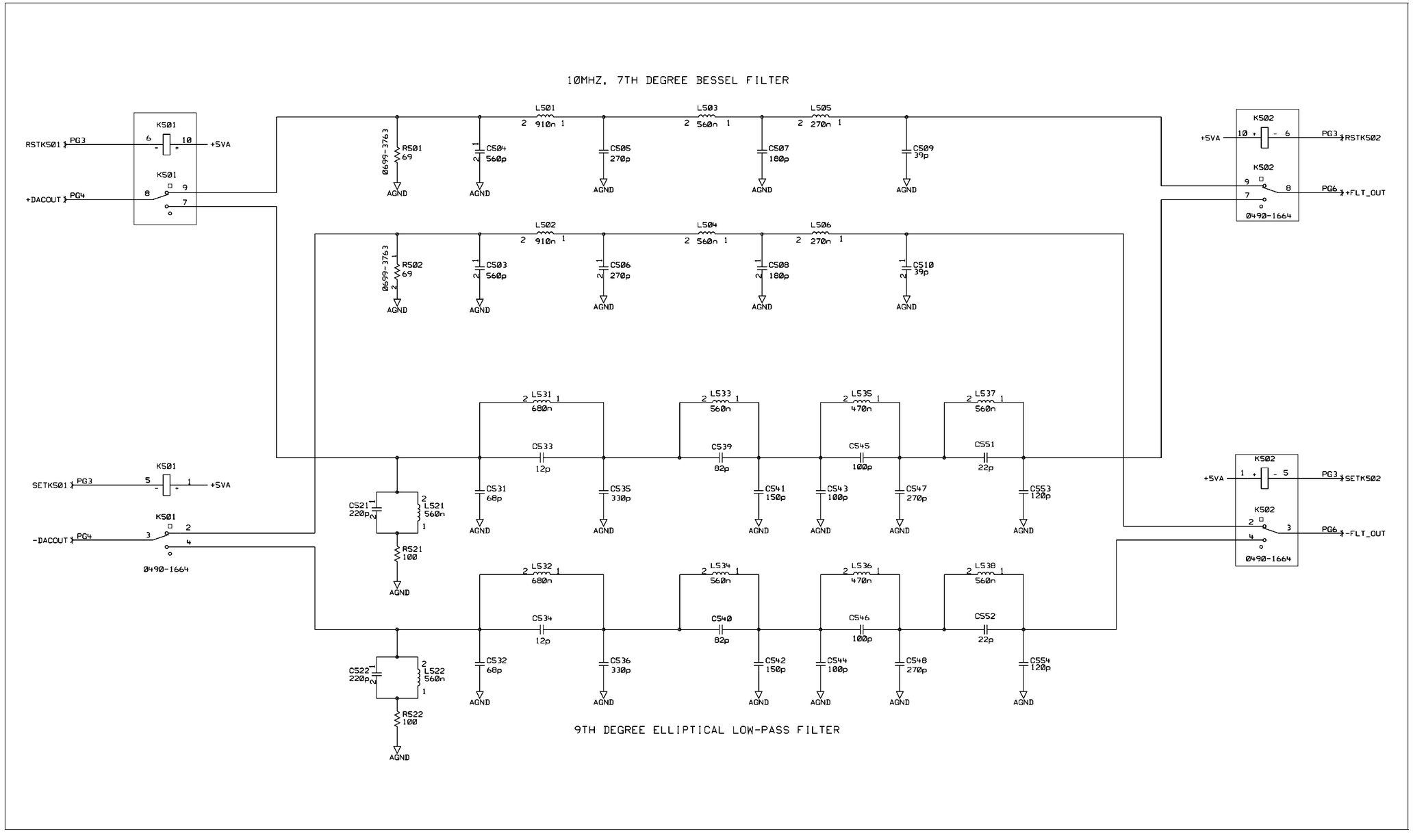


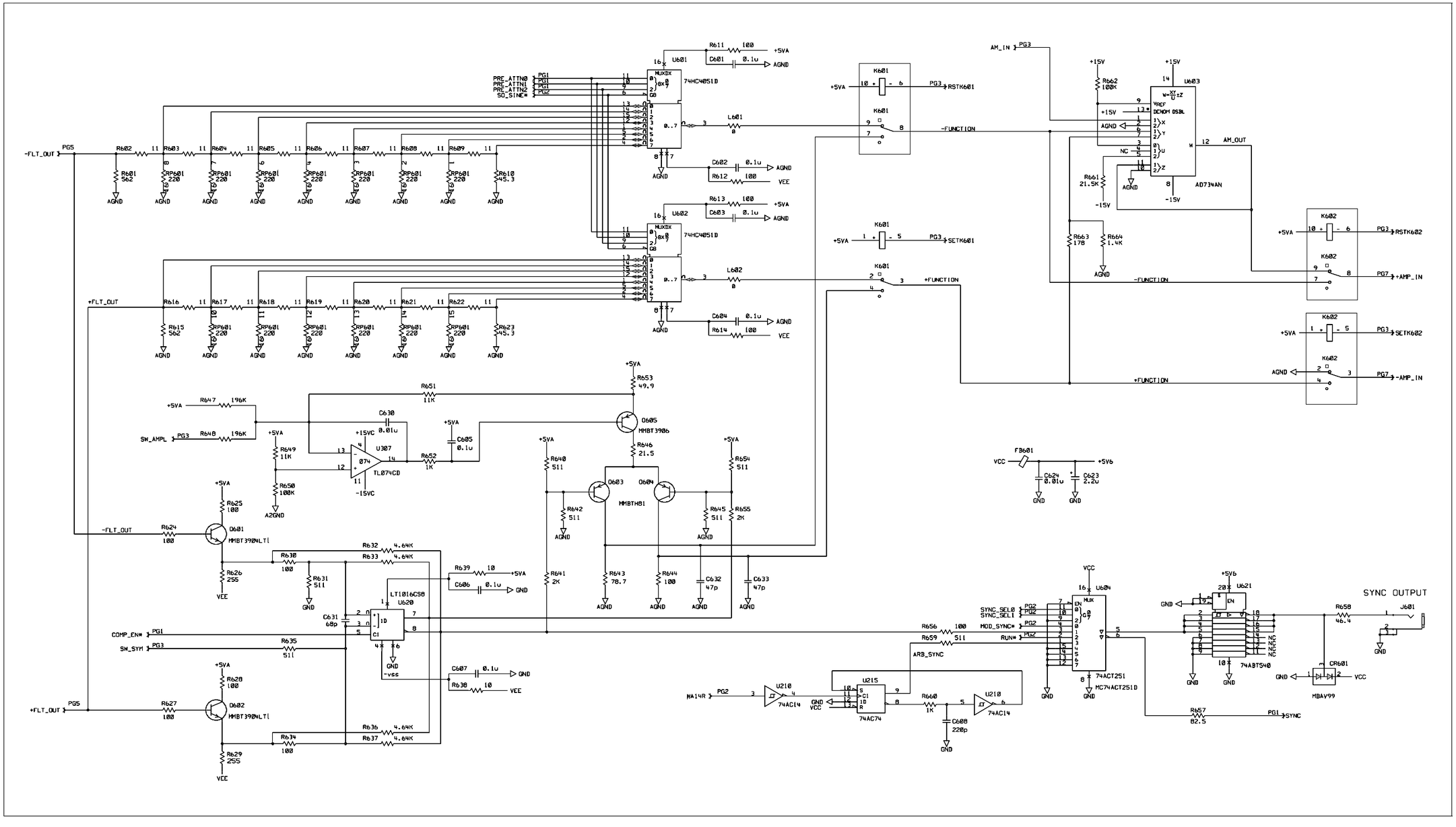
33120-66521 (sheet 2 of 10)
Digital Waveform Data Synthesis Schematic
132


+5VA1
R324
511
+5VA
XRLYRST
PG1
R310
4.64K
IXRLYRST
SHT_LOOP
LONG_SHT
SERDAT
SERCLK
SERSTB
U315
MUX
R321
1K
RLYDAT
R303
RLYCLK
R304
RLYSTB
74ACT257
1820-5943
GND
U301
U302
SRG8
6595
TPIC6595DW
SETK501
SETK502
SETK601
SETK602
RSTK501
RSTK502
RSTK601
RSTK602
A2GND
SERDATIA
SERDATI
R314
619
SERDAT2
R313
VCC
U305
74HCT4094
SERRBK
U303
DAC
AD1851R
C315
0.1u
R311
10
VEE
U304
74HC4051D
RP301
10K
C301
0.1u
C302
C303
C304
C305
C306
C317
C320
U306
U307
U314
TL074CD
+15VC
-15VC
RP302
R301
31.6K
C319
0.01u
R302
39.2K
R322
39.2K
R323
26.1K
R316
R305
PG3
+5.00REF
PG6
SW_SYM
SW_AMPL
PG7
OUT_OFFSET
PG4
AM_GAIN
AMP_CTL
AM_OFFSET
FREQ_ADJ
R307
4.99K
AM_INT_MOD
R318
R309
1.24K
U410
AM_IN
R319
R320
R317
1.78K
R308
CR301
MBAV99
EXT_AM
J301
1250-1884
C316
C311
C308
C312
C309
C318
C310
C313
C314
+5VA
+5VA1
VCC
VEE
CR302
CR303
+18V
-18V
3.3
BZX84C3V3

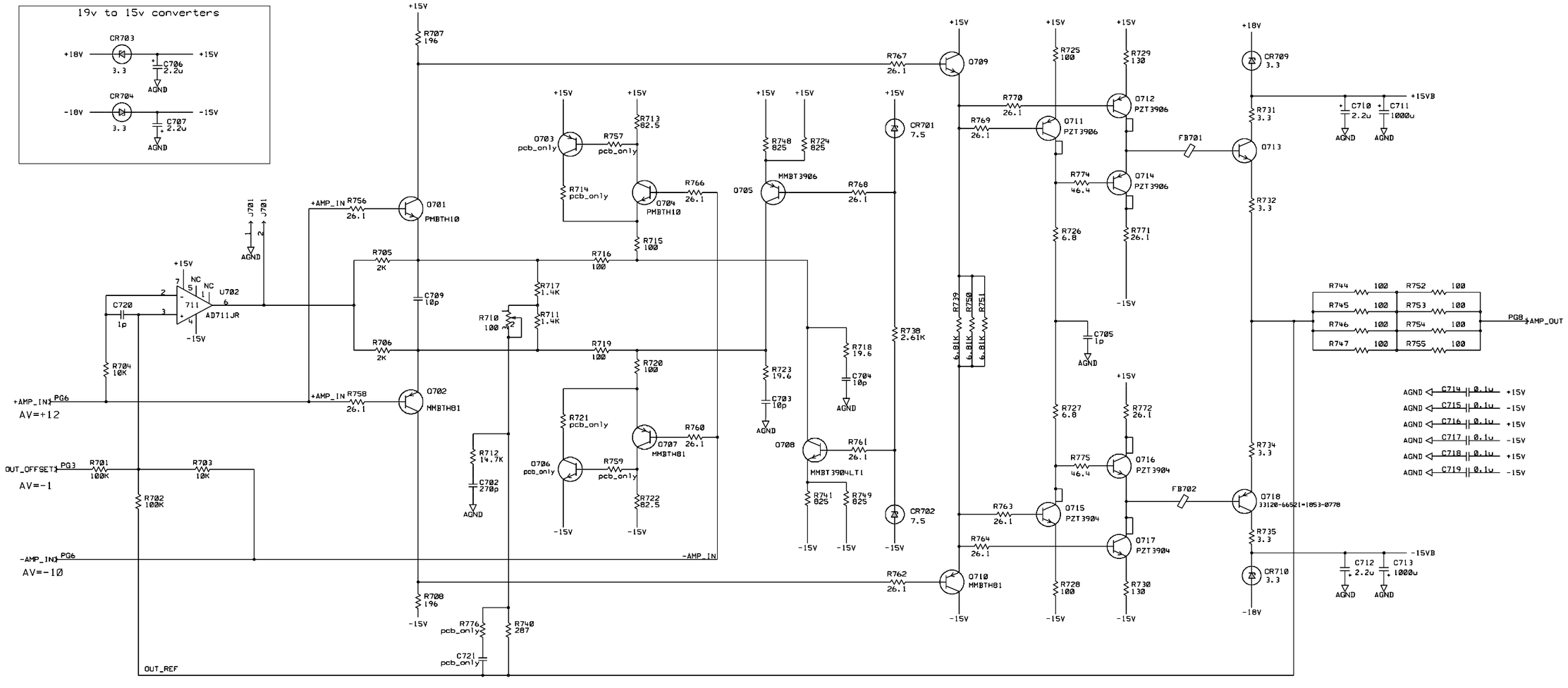


33120-66521 (sheet 4 of 10)
Waveform DAC Schematic
134

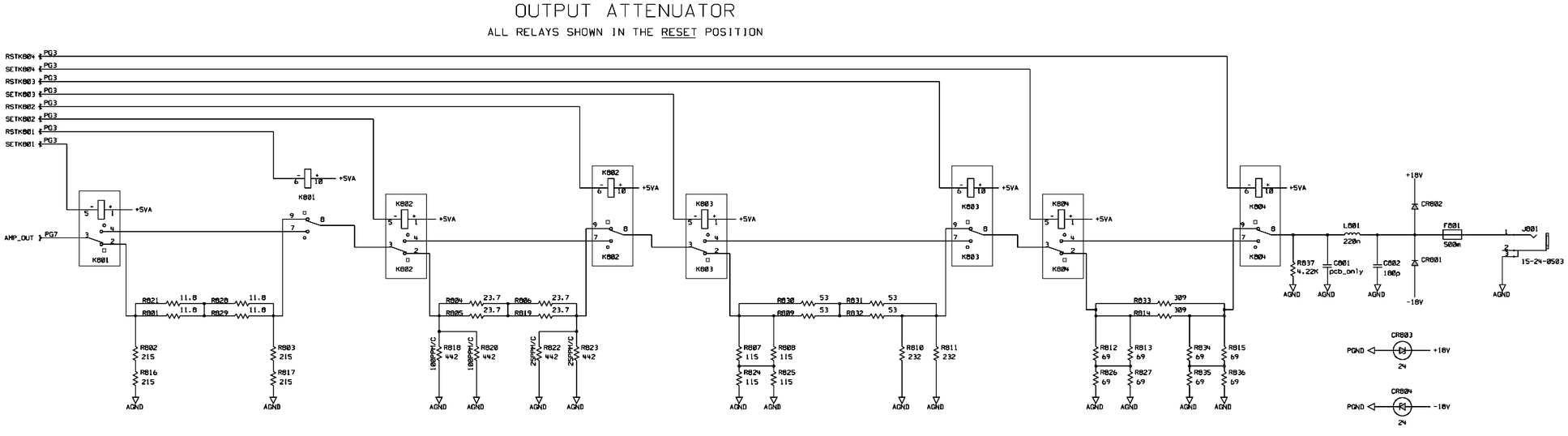

10MHZ, 7TH DEGREE BESSEL FILTER
9TH DEGREE ELLIPTICAL LOW-PASS FILTER
K501
RSTKS01
PG3
+DACOUT
PG4
+5VA
0490-1664
SETKS01
-DACOUT
K502
PG3 RSTKS02
PG6 +FLT_OUT
PG3 SETKS02
PG6 -FLT_OUT
L501 910n
L502 910n
L503 560n
L504 560n
L505 270n
L506 270n
L531 680n
L532 680n
L533 560n
L534 560n
L535 470n
L536 470n
L537 560n
L538 560n
0699-3763
R501 69
R502 69
R521 100
R522 100
C504 560p
C503 560p
C505 270p
C506 270p
C507 180p
C508 180p
C509 39p
C510 39p
C521 220p
C522 220p
L521 560n
L522 560n
C533 12p
C534 12p
C539 82p
C540 82p
C545 100p
C546 100p
C551 22p
C552 22p
C531 68p
C532 68p
C535 330p
C536 330p
C541 150p
C542 150p
C543 100p
C544 100p
C547 270p
C548 270p
C553 120p
C554 120p
AGND



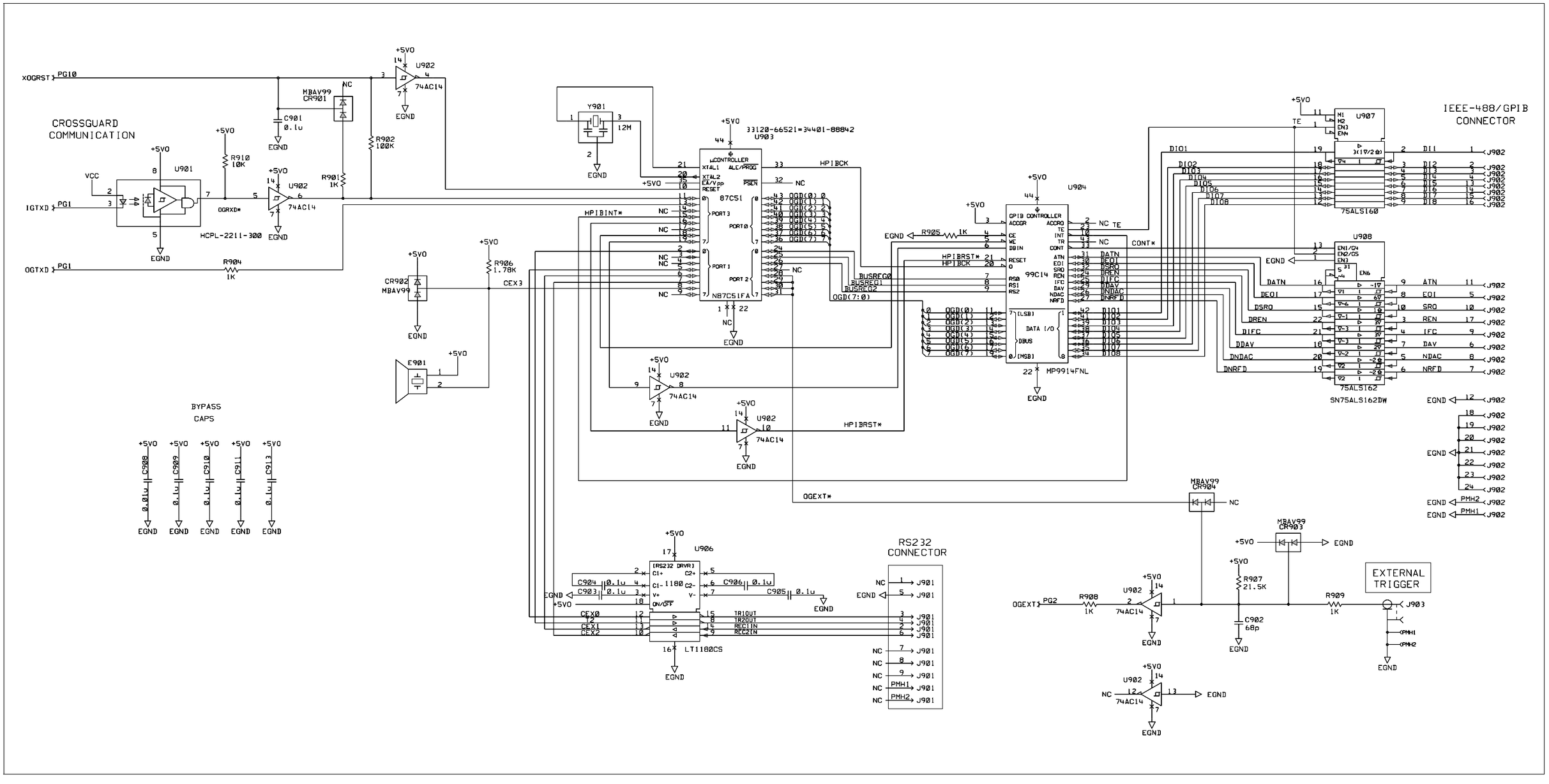
33120-66521 (sheet 6 of 10)
Sync, Square Wave, and Attenuator Schematic
136



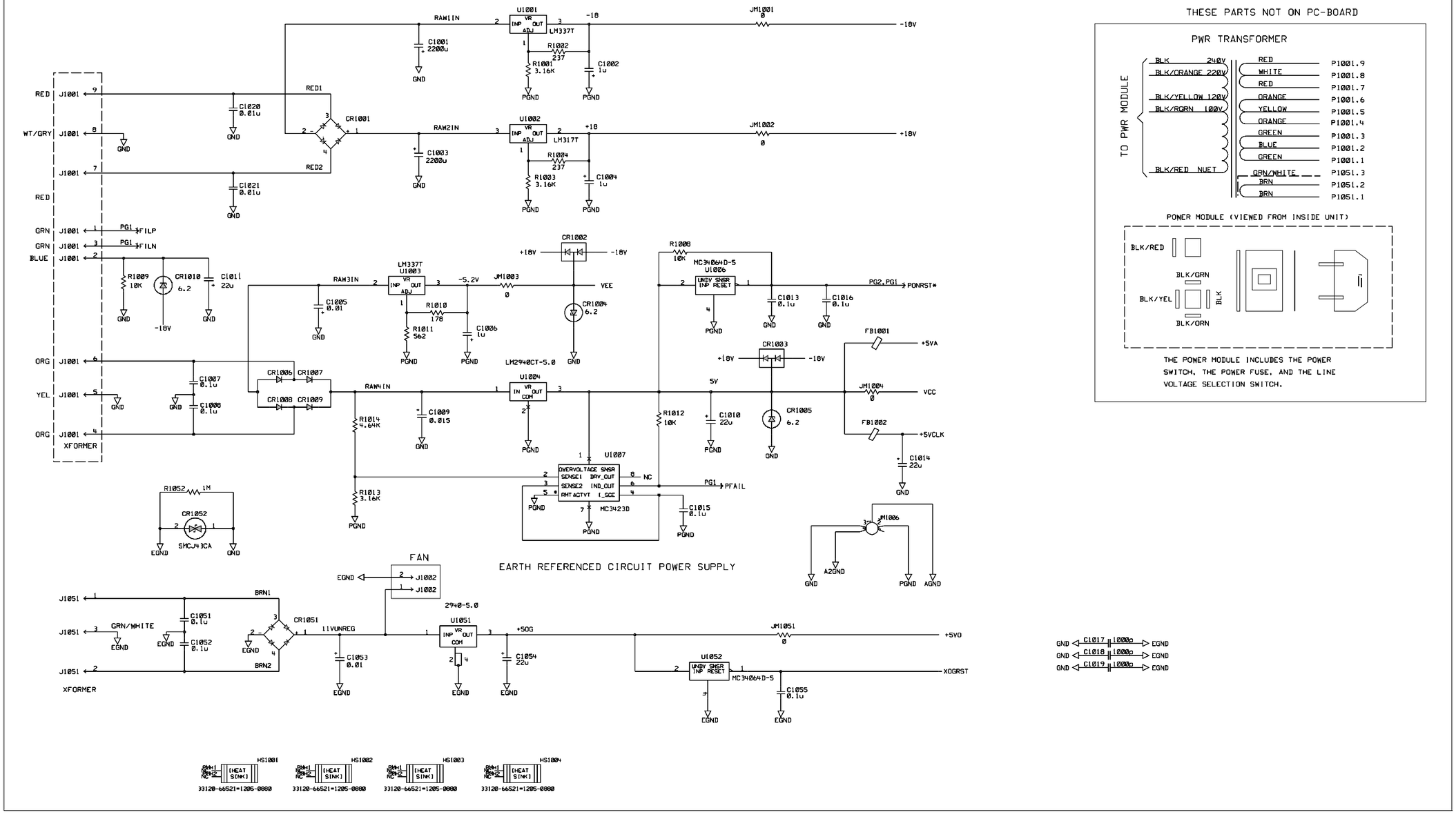
33120-66521 (sheet 7 of 10)
Output Amplifier Schematic
137



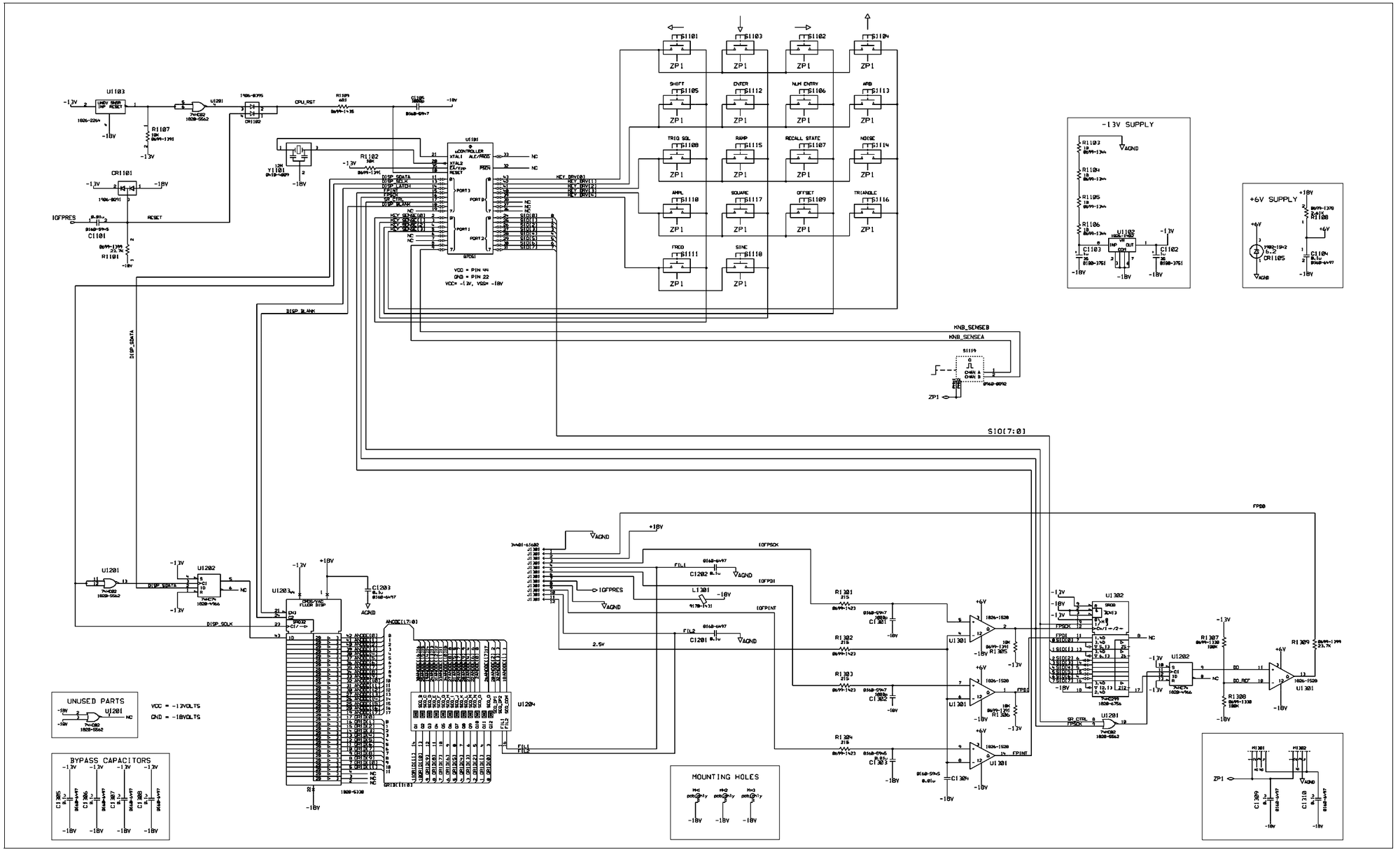
33120-66521 (sheet 8 of 10)
Output Attenuator Schematic
138



33120-66521 (sheet 9 of 10)
Earth Reference Logic Schematic
139



33120-66521 (sheet 10 of 10)
Power Supplies Schematic
140

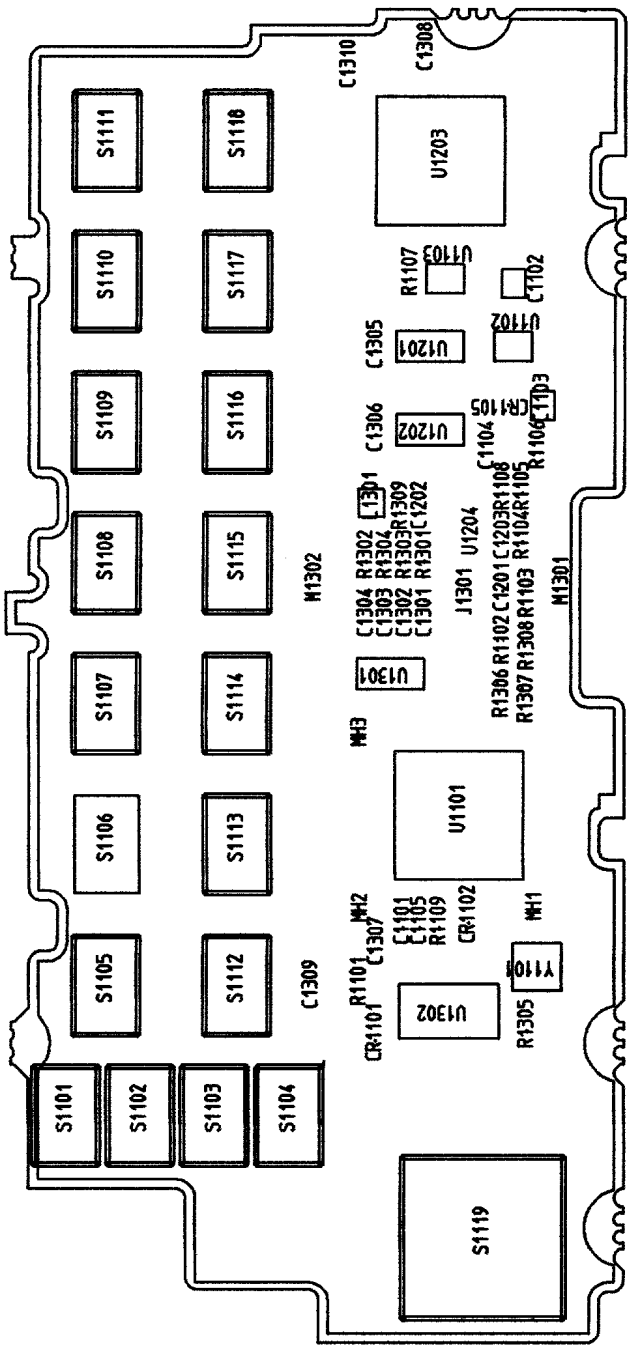


33120-66502 (sheet 1 of 1)
Display and Keyboard Schematic
141

TOP SIDE 33120-66521 REV A

33120-66521 Component Locator Diagram

TOP SIDE 33120-66502 REV C



33120-66502 Component Locator Diagram

Manual Part Number

33120-90017, March 2002
(*order as 33120-90104 manual set*)

Edition

Edition 6, March 2002
Edition 5, August 1997
Edition 4, February 1996
Edition 3, May 1994
Edition 2, March 1994
Edition 1, January 1994

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Loveland, Colorado 80537 U.S.A.

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Earth ground symbol.

Chassis ground symbol.

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WARNING

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