

3.4.8 Power

See circuit diagram Figure 9-9.

Power Sources , Operating Modes

Figure 3-11 shows a simplified diagram of the power supply and battery charger circuit.

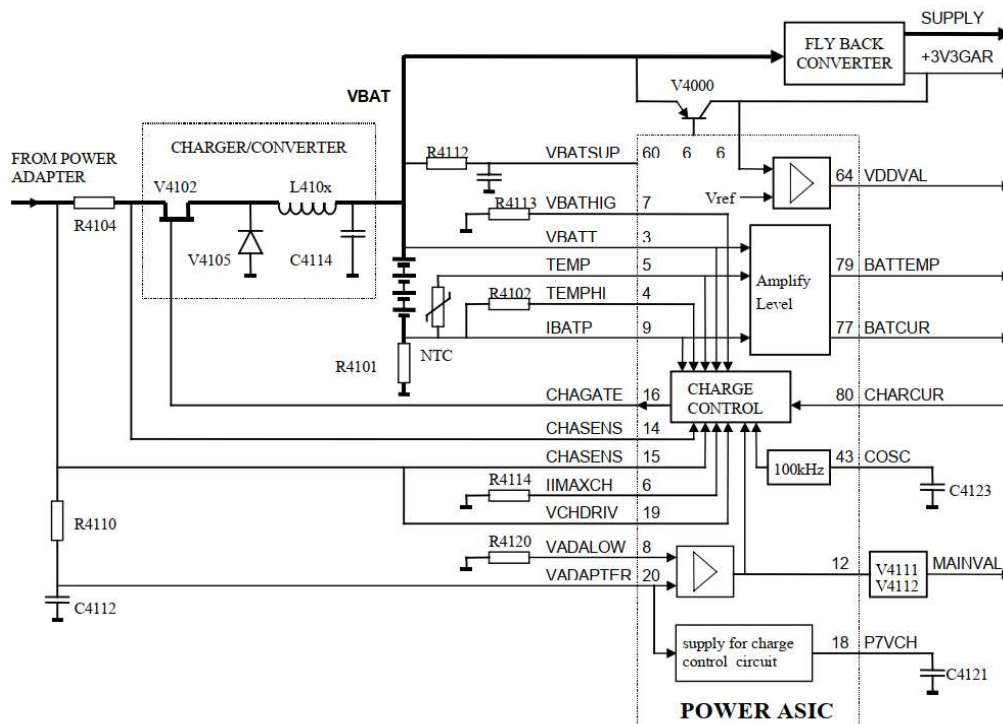


Figure 3-11. Power Supply Block Diagram

As described in Section 3.3 the test tool operating mode depends on the connected power source.

3-23

Fluke 192B/196B-C/199B-C

Service Manual

3-24

The voltage VBAT is supplied either by the power adapter via V4102/L410x, or by the battery pack. It powers a part of the P-ASIC via R4112 to pin 60 (VBATSUP). If the test tool is off, the Fly Back Converter is off, and VBAT powers the D-ASIC via transistor V4000 (+3V3GAR). This +3V3GAR voltage is controlled and sensed by the P-ASIC. If it is NOT OK ($<3.05V$), the output VDDVAL (pin 64) is low. The VDDVAL line is connected to the D-ASIC, and if the line is low, the D-ASIC is inactive: the test tool is in the **Idle mode**. A low VDDVAL line operates as a reset for the D-ASIC.

If VDDVAL is high ($+3V3GAR > 3.05V$), the D-ASIC becomes active, and the **Off mode** is entered. The D-ASIC monitors the P-ASIC output pin 12 via V4111-V4112 (MAINVAL), which indicates the presence of the power adapter voltage (high = present). The D-ASIC also monitors the test tool ON/OFF status (by pressing the ON/OFF key, a bit in the D-ASIC, indicating the test tool ON/OFF status is toggled). If neither a correct power adapter voltage is supplied (MAINVAL is low), nor the test tool is turned on, the **Off mode** will be maintained.

If a correct power adapter voltage is supplied (MAINVAL high), or if the test tool is turned on, the mask software starts up. The mask software checks if valid instrument software is present. If not, e.g. no instrument firmware is loaded, the mask software will keep running, and the test tool is not operative: the test tool is in the **Mask active** state.

For test purposes the mask active mode can also be entered by pressing the ^ and > key when the test tool is turned on. If valid software is present, one of the three modes **Operational**, **Operational & Charge** or **Charge** will become active. The Charger/Converter circuit is active in the Operational & Charge and in the Charge mode. The Fly back converter is active in the Operational and in the Operational & Charge mode.

Charger/Converter (See Figure 3-11.)

The power adapter powers the Charge Control circuit in the P-ASIC via an internal linear regulator. The power adapter voltage is applied to R4104. The Charger/Converter circuit controls the battery charge current. If a charged battery pack is installed, the nominal VBAT is 7.2 V (up to 9 V). If no battery pack is installed, VBAT is about 11 V.

The voltage VBAT is supplied to the battery pack, to the P-ASIC, to the Fly Back Converter, and to transistor V4000. The FET control signal CHAGATE is a 100 kHz square wave voltage with a variable duty cycle, supplied by the P-ASIC Control circuit.

The duty cycle determines the amount of energy loaded into L410x/C4114. By controlling the voltage VBAT, the battery charge current can be controlled. The various test tool circuits are supplied by the Fly Back Converter, and/or V4000.

Required power adapter voltage

The P-ASIC supplies a current to reference resistor R4120 (VADALOW pin 8). It compares the voltage on R4120 to the power adapter voltage VADAPTER on pin 20 (supplied via R4110, and attenuated in the P-ASIC). If the power adapter voltage is below 14 V, the P-ASIC output pin 12, and the line MAINVAL, are low. This signal on pin 12 is also supplied to the P-ASIC internal control circuit, which then makes the CHAGATE signal high. As a result FET V4102 becomes non-conductive, and the Charger/Converter is off.

Battery charge current

The actual charge current is sensed via resistor R4101, and filter R4103-C4102, on pin 9 of the P-ASIC (IBATP). The sense voltage is supplied to the control circuit in the P-ASIC. The required charge current information is supplied by the D-ASIC via the CHARCUR line and filter R4121-C4122 to pin 80. A control loop in the control circuit adjusts the actual charge current to the required value.

Depending on the required charge current the filtered CHARCUR voltage range on pin 80 is:

- 0 V for a 1 A charge current.
- 1.75 V for a 0.35 A charge current
- 2.5 V for a 0.09 A charge current
- 2.6 V for a 0.06 A charge current
- 2.7 V for no charge current (0 A), for example if the battery temperature limit is exceeded (>50 °C)
- > 3 Volt if the charger converter is off (V4102 permanently non-conductive). This happens for example if no BC190 is connected

The D-ASIC derives the required charge current value from the battery voltage VBAT. The D-ASIC measures this voltage via the Slow ADC (see 3.4.9. Slow ADC). The momentary value, and the temperate change as a function of time ($-dT/dt$), are used as control parameters. If the dT/dt exceeds 0.75 °C per minute the battery is full.

Battery low indication

The battery empty indication on the LCD is given for a battery voltage < 6.9 V. If the voltage drops below 6.0 V, the test tool turns off.

Charging the battery

Battery Refresh

If a battery refresh is started the following actions are performed:

- the 1 A charge current is applied to the battery until it is full
- the charger is turned off, and as much as possible circuits are activated in order to discharge the battery in the shortest time. The initial discharge current is about 1 A.
- when the battery is discharged (battery voltage < 6.4V) the 1 A charge current is applied until the battery is full; then the 90 mA charge current is applied continuously. Battery Charger BC190 connected, test tool off, battery completely discharged
- the 1 A charge current is applied until the battery is full (takes about 3.5 hrs)
- the 0.35 A charge current is applied for 2 hrs.
- the 90 mA charge current is applied continuously. Battery Charger BC190 connected, test tool on
- the 60 mA charge current is applied continuously.

Battery temperature monitoring

The P-ASIC supplies a current to a NTC resistor in the battery pack (TEMP pin 5, battery connector pin 3). The P-ASIC conditions the voltage on pin 5 and supplies it to output pin 79 BATTEMP. The D-ASIC measures this voltage via the slow ADC. It uses the BATTEMP voltage for control purposes (set charge current).

Additionally the temperature is monitored by the P-ASIC. The P-ASIC supplies a current to reference resistor R4102 (TEMPHI pin 4), and compares the resulting TEMPHI voltage to the voltage on pin 5 (TEMP). If the battery temperature is too high, the P-ASIC Control circuit will set the charge current to zero, in case the D-ASIC fails to do this.

During charging, the measured temperature change as a function of time ($-dT/dt$) is used to see if the battery is completely charged. If the battery temperature monitoring system fails, a temperature switch in the battery pack interrupts the battery current if the temperature becomes higher than 70 °C

Maximum VBAT

The P-ASIC supplies a current to reference resistor R4113 (VBATHIGH pin 7). It compares the voltage on R4113 to the battery voltage VBAT on pin 3 (after being attenuated in the P-ASIC). The P-ASIC limits the voltage VBAT to 11 V via its internal Control circuit. This situation arises in case no battery or a defective battery (open) is present.

Battery Identity

The BATTIDENT line (pin 90) is connected to R4100 on the Power Circuit, and to a resistor in the battery pack. The voltage level indicates the installed battery type. If the battery is removed, the BATTIDENT line goes high.

Charger/Converter input current

The input current is sensed by R4104. The P-ASIC supplies a reference current to R4114. The P-ASIC compares the voltage drop on R4104 (CHASENSP-CHASENSN pin 14 and 15) to the voltage on R4114 (IMAXCHA pin 6). It limits the input current (e.g. when loading C4114 and C4000/C4001 just after connecting the power adapter) via its internal Control circuit.

CHAGATE control signal

The CHARGE CONTROL circuit in the P-ASIC supplies the CHAGATE control signal. The control circuit end stage supply voltage is VCHDRIVE. The CHAGATE high level makes V4102 non-conductive ("OFF", $V_{gs} > 0$). The CHAGATE low level is limited to VCHDRIVE minus 13V, and makes V4102 conductive ("ON", V_{gs} negative).

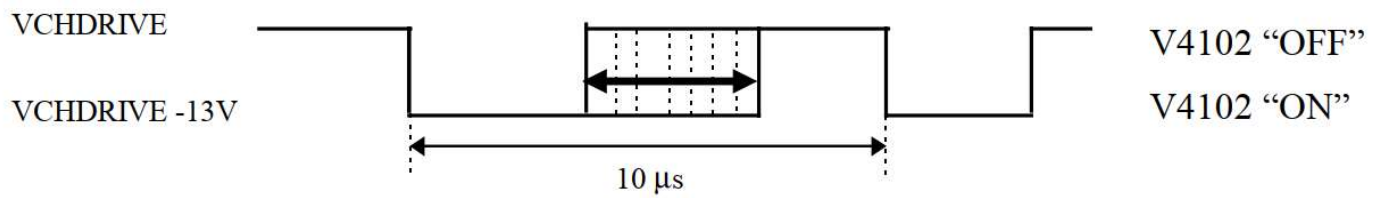


Figure 3-12. CHAGATE Control Voltage