

6.1.4. Power supply (unit A15 page 6—157 and A16 page 6—166)

The mains voltage is applied via the mains filter and the mains selector switch on the AC POWER UNIT A16 to a rectifier where it is full-wave rectified and fed to a regulated sine-converter (oscillator and switching circuit). The output voltage of the sine converter is kept constant by regulating the duty cycle of the applied voltage by a special integrated circuit.

This output voltage is applied to the primary of a transformer, the secondary voltages of this transformer are applied to DC POWER unit A15 where they are full-wave rectified, smoothed and applied to the various circuits. Also the voltages for the C.R.T. filament and the C.R.T. cathode ($-1,5$ kV) are generated here. The -1.5 kV is also applied to the EHT unit A23 which gives a high tension for g8 of the C.R.T.

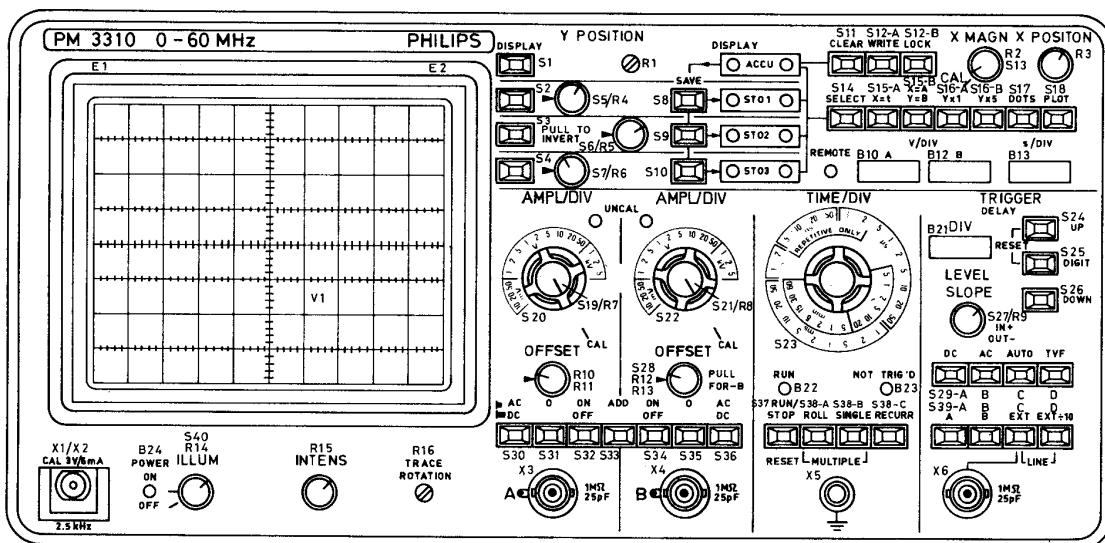
The MAINS triggering is taken direct from the mains and, via an opto-isolator, fed to the trigger circuitry on a safe level.

6.2. UNIT DESCRIPTIONS

6.2.1. Front side unit A1

The front side unit consists of an aluminium front cast on which the following items are mounted.

- LED B24 + LED-holder
- Light reflector assembly inclusive two lampholders and two 28 V - 80 mA lamps E1 and E2.
- CAL output terminals X1 and X2.
- Measuring earth socket X5.
- LEVEL/SLOPE control R9/S27.
- INTENS control R15.
- TRACE ROTATION control R16.
- Trigger mode selector switch S29.



6.2.15. DC power unit A15

The DC power unit A15 contains the following circuits:

- DC output circuits
- High voltage converter and EHT unit
- Memory back-up circuit
- Protection circuit for the +5 V
- Cathode-ray tube circuit
- Z-amplifier circuit
- Illumination circuit
- Line signal circuit

Each of these circuits is now separately described.

DC output circuits

The voltages on the secondary windings of transformer T1602 on the AC power unit A16 are applied to several rectifiers and voltage doublers.

The bridge rectifiers provide for the +5 V, -5 V, +6 V, -6 V, +12 V, -12 V and +40 V supply voltages. The voltage doublers provide for the +125 V and -125 V supplies.

A -5 A supply voltage is derived from the -12 A via D1501.

A +6.5 V supply is derived from the +12 A by R1561, C1547 and V1544.

A +94 V supply is derived from the +125 V via R1572, C1548 and zener diodes V1554, V1556.

The secondary windings providing the voltages for the various circuits in the oscilloscope are completely isolated from the mains power supply.

Each supply voltage is individually rectified and smoothed.

The filament of the c.r.t. is supplied by the 6.3 V heater voltage between f_1 and f_2 .

High-voltage converter and EHT unit

A sine-wave converter formed by transformer T1501 and V1501 converts the +40 V d.c. into 1500 V a.c. with a frequency of approximately 30 kHz.

This voltage is applied to a voltage multiplier on EHT unit A23. The output voltage of this multiplier, 6.5 kV, is applied to g8 of the c.r.t.

Furthermore, the converter output of 1500 V is also rectified and smoothed by V1502, C1502, R1514 and C1503 and applied to the c.r.t. cathode. It is also fed back to the positive input of operational amplifier D1503 to stabilise the cathode voltage of the c.r.t. and thus prevent any variations in c.r.t. sensitivity.

A reference voltage, obtained from divider R1578, R1591 and R1577 is applied to the negative input pin 2 of operational amplifier D1503.

The resulting voltage on pin 6 of D1503 now controls the high-voltage converter via R1526.

Memory back-up circuit

Two 1.5 V batteries can be fitted in the instrument for memory back-up.

When this battery back-up facility is used, the information that was stored in the random-access memories (RAMs) before switch-off (i.e. signal information and switch settings) is saved when the POWER switch is OFF.

The RAM memories are normally supplied by the voltage +5 BATT, which is derived from the +5 V via transistor V1549 when the instrument is switched on. In this case, the batteries are protected by diode V1546. When the POWER switch is OFF, the supply for the RAM memories is obtained from the batteries via V1546.

Protection circuit for the +5 V

This circuit protects the TTL circuits in the instrument from damage caused by an excessively high +5 V supply. When, for some reason, the +5 V supply increases to a value above 6 V approx., this +5 V supply is switched off by thyristor V1551 under the control of SCS V1527.

Cathode-ray tube circuit

In addition to the c.r.t., this circuit includes the intensity, focus, astigmatism, trace rotation and geometry controls.

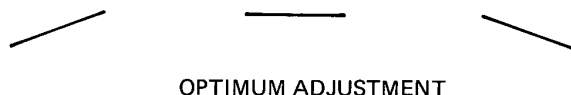
C.r.t. controls

By means of the front-panel INTENS potentiometer R15, the intensity of the display can be continuously controlled.

Focussing of the trace is only possible by means of the internal FOCUS potentiometer R1506 (coarse control) and R1588 (fine control).

Trace rotation is achieved by the trace rotation coil circuit. The coil is mounted inside a mu-metal screen and provides a magnetic field for rotational control of the entire scan. The degree and direction of rotation is determined by the setting of the TRACE ROTATION front-panel preset R16 (screwdriver-operated).

The slider of R16 is connected to the bases of complementary emitter-followers V1558, V1559. The trace rotation coil current is supplied by these transistors, only one conducting at a time depending on the setting of R16.



The ASTIGMATISM control R1587 enables the form of the spot to be adjusted by influencing the voltage on c.r.t. grids G2/G4.



Barrel and pin-cushion distortion are automatically minimised by the signal X-Y GEM connected to G5, G6 and G7. In this way, these screening grids are connected to a potential equivalent to the mean voltage of the deflection plates. The signal X-Y GEM is generated in the final amplifier unit A20.

*Z-amplifier circuit**a. Intensity control*

The output voltage of amplifier D1502 can be varied by INTENS potentiometer R15, to give variable illumination of the c.r.t. trace.

The Z-amplifier receives an input signal ZIN which originates in the microprocessor unit A4. When necessary, the trace is blanked by this signal ZIN, which is the final outcome of a number of different blanking situations occurring in this instrument. Signal ZIN is amplified by the stage incorporating transistors V1547 and V1553. Transistor V1553 acts as a constant-current source. At the output of this amplifier the a.c. and d.c. components of the blanking signal are routed along different paths. The a.c. path is via blocking capacitor C1518 directly to the Wehnelt cylinder of the c.r.t. The d.c. component of the signal is fed to the emitters of V1541 and V1537 via a low-pass T-filter, R1571, C1555 and R1569.

The signal is modulated by a frequency of 156 kHz applied to V1541 via diode V1552. The resulting a.c. voltage on the collector of V1537 has a peak-to-peak value that depends on the output voltage of the low-pass filter.

The a.c. collector voltage of V1537 is applied via a symmetrical emitter-follower V1526, V1533 to a peak detector. This peak detector (C1522, V1517, V1516, R1518 and C1516) rectifies the a.c. voltage. Finally, this rectified voltage is added to the cathode voltage and applied to the Wehnelt cylinder G1.

The signal is split into its a.c. and d.c. components in order to isolate the cathode and Wehnelt cylinder, which stand at -1500 V, from the other circuits.

Adjustment of the black level is achieved by potentiometer R1589 in the emitter circuit of V1537 in the d.c. amplifier.

b. Focussing control

The electron beam is focussed using internal focus potentiometer R1588, which controls the emitter voltage of transistors V1539 and V1536. The signal is modulated by a frequency of 156 kHz applied to V1539 via diode V1552. On the collector of V1536 a signal is produced, the amplitude of which depends on the position of potentiometer R1588 (and R15 INTENS).

The a.c. voltage on the collector of V1536 is applied via symmetrical emitter-follower V1524, V1532, to a peak detector. This peak detector (C1521, V1514, V1513, R1516 and C1514) rectifies the a.c. voltage. Finally, this rectified voltage is added to the voltage set by potentiometer R1506 (part of a voltage divider network across the high-voltage converter output) and then applied to the focussing anode g3 of the c.r.t. In this way, the focus voltage also depends on the position of the INTENS potentiometer, which determines the voltage across the divider network R1502, R1506, R1509. This provides a measure of compensation, so that the focus of the electron beam is automatically adapted when the intensity of the trace is varied.

Illumination circuit

The graticule can be illuminated by the indicator lamps E1 and E2. The intensity can be varied by the front-panel ILLUM potentiometer R14, which controls the base, and hence the collector current of transistor V1561, which flows through the lamps. Note that the illumination circuit is not short-circuit proof.

Line signal circuit

The line signal circuit produces a sine-wave voltage for mains triggering that is derived from the input mains voltage.

Photocoupler D1602 on unit A16, which provides isolation between the mains voltage and the oscilloscope circuits, drives the V1564 circuit into saturation, which means that the square-wave voltage appearing on its collector has the same amplitude value for all mains voltages.

The original sine-wave is re-constructed by means of an integrator network R1553, R1551, R1536 and C1546, C1543, C1541.

This signal, LINE, is applied via V1523 and V1531 to the trigger selector.

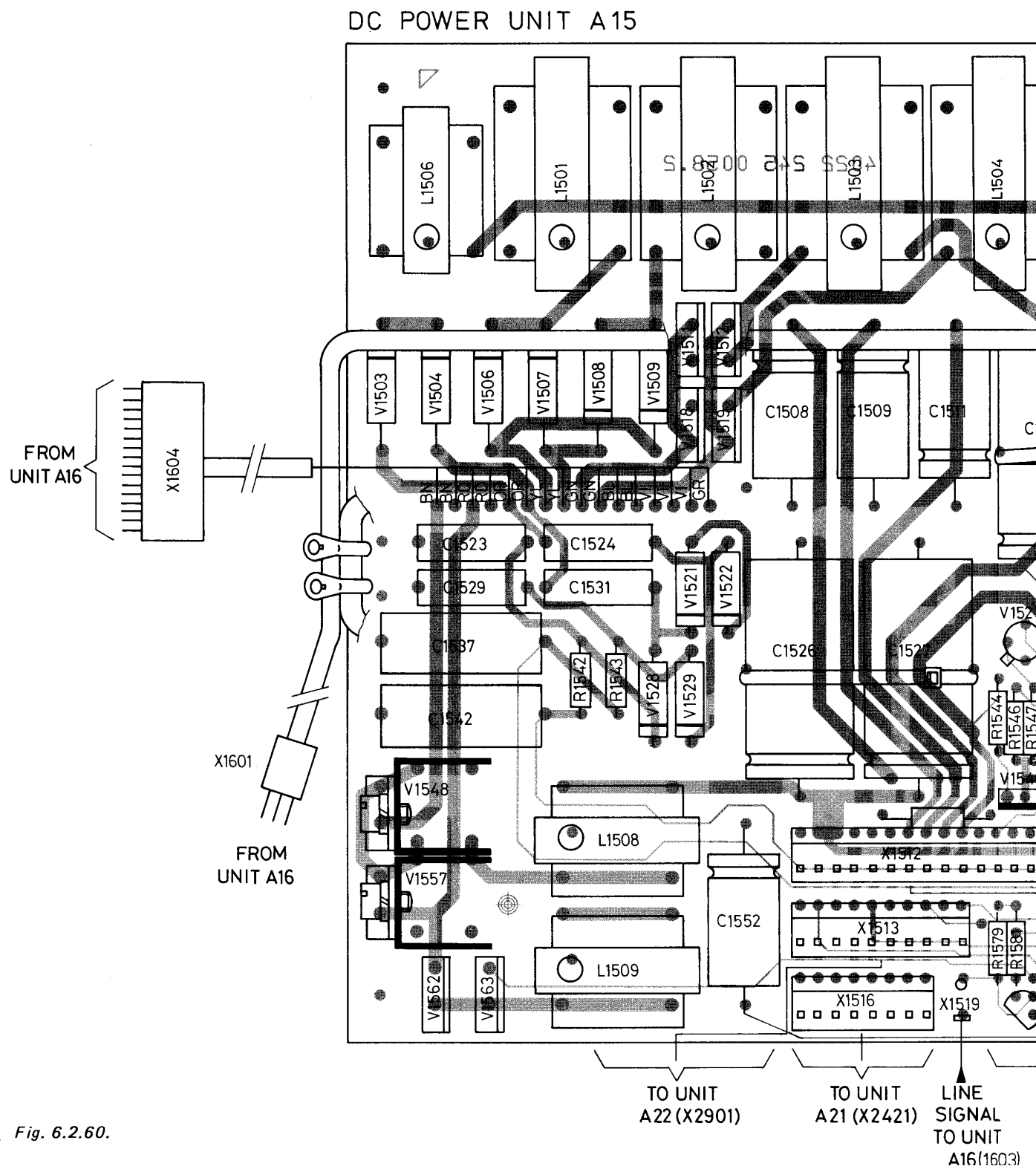
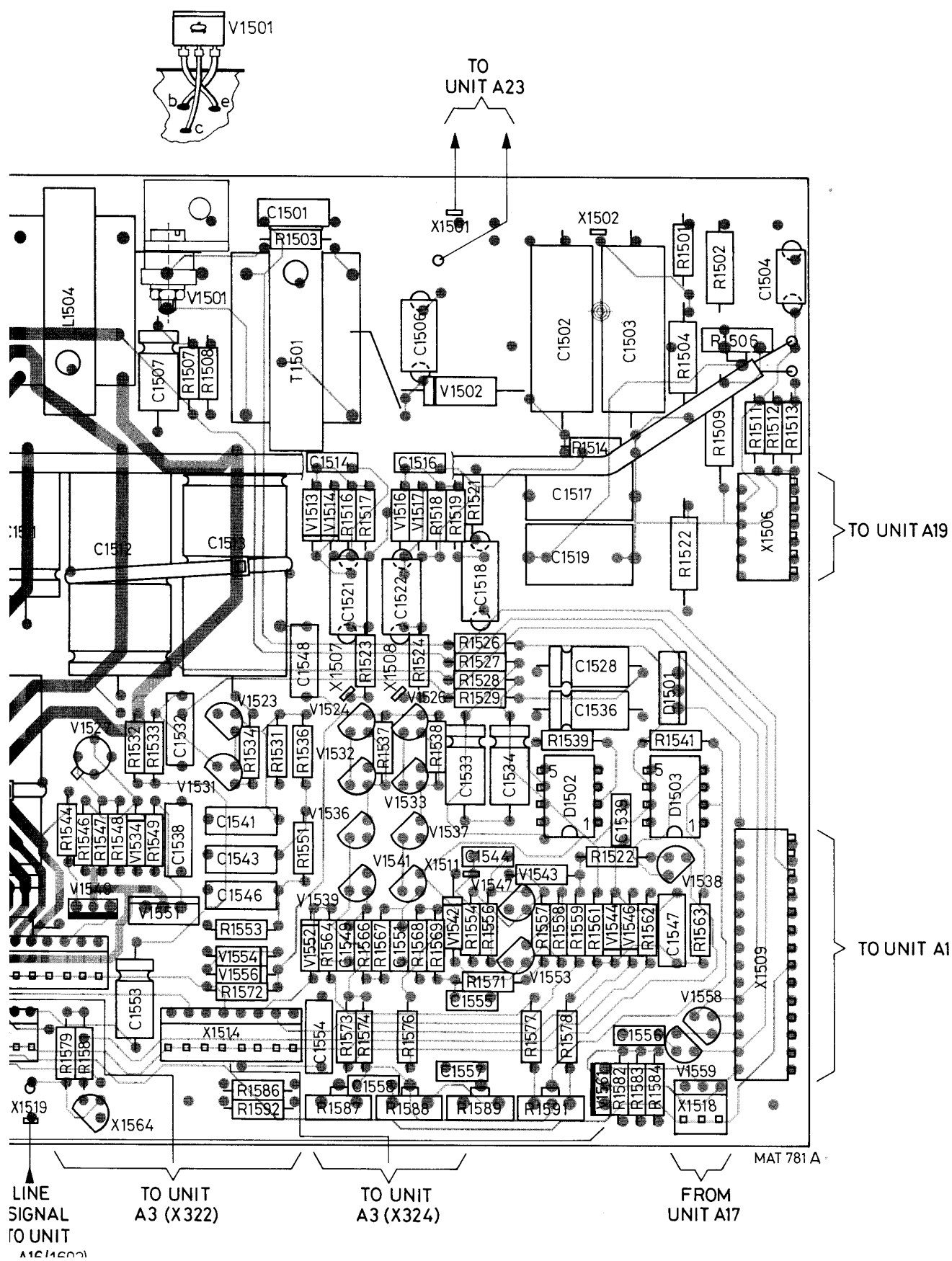
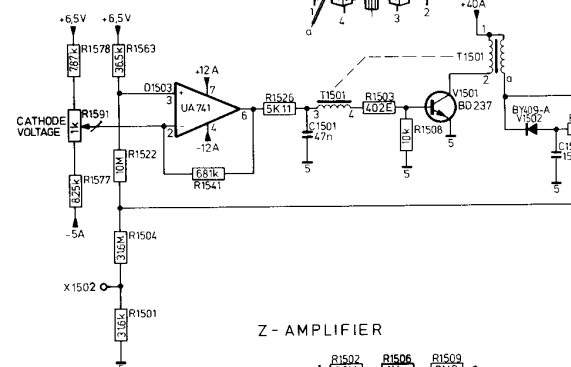
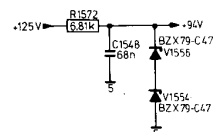
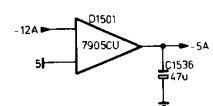
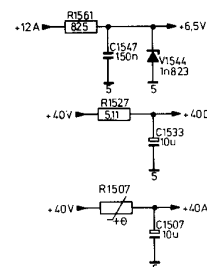
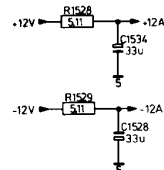
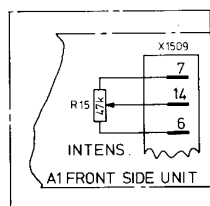
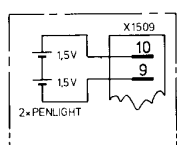


Fig. 6.2.60.



The schematic diagram illustrates the internal circuitry of a power supply unit (PSU) for a computer system. The input is connected to a terminal block labeled X1601, which provides three lines: 3, 1, and 16. The output is connected to a terminal block labeled X1512, which provides 13 lines: 1c, 13c, 12c, 14c, 8c, 7c, 5c, 6c, 9c, 11c, 10c, and 4c. The circuit includes a transformer with primary windings R1512 and R1513, and secondary windings R1502, R1501, R1503, and R1506. The transformer is connected to a bridge rectifier circuit consisting of four diodes (V1548, V1563, V1557, V1562) and four capacitors (C1526, C1527, C1552, C1529). The output of the rectifier is connected to a filter capacitor (C1524) and a voltage divider (R1543, R1529) to provide a +125V output. The circuit also includes a 150nF capacitor (C1524) and a 150nF capacitor (C1531) connected to chassis ground. The output voltages are: +5V, -5V, -5.2V, +6V, -6V, -12V, -12V, +40V, -12V, +6V, -6V, +12V, -12V, +40V, -125V, +125V, +5V, and +6V. The components are labeled with their respective values: L1508, L1509, L1501, L1502, L1503, L1506, C1526, C1527, C1552, C1529, C1524, C1531, R1512, R1513, R1502, R1501, R1503, R1506, R1543, R1529, V1548, V1563, V1557, V1562, V1507, V1508, V1509, V1510, V1511, V1512, V1513, V1514, V1515, V1516, V1517, V1518, V1519, V1520, V1521, V1522, V1523, V1524, V1525, V1526, V1527, V1528, V1529, V1530, V1531, V1532, V1533, V1534, V1535, V1536, V1537, V1538, V1539, V1540, V1541, V1542, V1543, V1544, V1545, V1546, V1547, V1548, V1549, V1550, V1551, V1552, V1553, V1554, V1555, V1556, V1557, V1558, V1559, V1560, V1561, V1562, V1563, V1564, V1565, V1566, V1567, V1568, V1569, V1570, V1571, V1572, V1573, V1574, V1575, V1576, V1577, V1578, V1579, V1580, V1581, V1582, V1583, V1584, V1585, V1586, V1587, V1588, V1589, V1590, V1591, V1592, V1593, V1594, V1595, V1596, V1597, V1598, V1599, V1600, V1601, V1602, V1603, V1604, V1605, V1606, V1607, V1608, V1609, V1610, V1611, V1612, V1613, V1614, V1615, V1616, V1617, V1618, V1619, V1620, V1621, V1622, V1623, V1624, V1625, V1626, V1627, V1628, V1629, V1630, V1631, V1632, V1633, V1634, V1635, V1636, V1637, V1638, V1639, V1640, V1641, V1642, V1643, V1644, V1645, V1646, V1647, V1648, V1649, V1650, V1651, V1652, V1653, V1654, V1655, V1656, V1657, V1658, V1659, V1660, V1661, V1662, V1663, V1664, V1665, V1666, V1667, V1668, V1669, V1670, V1671, V1672, V1673, V1674, V1675, V1676, V1677, V1678, V1679, V1680, V1681, V1682, V1683, V1684, V1685, V1686, V1687, V1688, V1689, V1690, V1691, V1692, V1693, V1694, V1695, V1696, V1697, V1698, V1699, V1700, V1701, V1702, V1703, V1704, V1705, V1706, V1707, V1708, V1709, V1710, V1711, V1712, V1713, V1714, V1715, V1716, V1717, V1718, V1719, V1720, V1721, V1722, V1723, V1724, V1725, V1726, V1727, V1728, V1729, V1730, V1731, V1732, V1733, V1734, V1735, V1736, V1737, V1738, V1739, V1740, V1741, V1742, V1743, V1744, V1745, V1746, V1747, V1748, V1749, V1750, V1751, V1752, V1753, V1754, V1755, V1756, V1757, V1758, V1759, V1760, V1761, V1762, V1763, V1764, V1765, V1766, V1767, V1768, V1769, V1770, V1771, V1772, V1773, V1774, V1775, V1776, V1777, V1778, V1779, V1780, V1781, V1782, V1783, V1784, V1785, V1786, V1787, V1788, V1789, V1790, V1791, V1792, V1793, V1794, V1795, V1796, V1797, V1798, V1799, V1800, V1801, V1802, V1803, V1804, V1805, V1806, V1807, V1808, V1809, V1810, V1811, V1812, V1813, V1814, V1815, V1816, V1817, V1818, V1819, V1820, V1821, V1822, V1823, V1824, V1825, V1826, V1827, V1828, V1829, V1830, V1831, V1832, V1833, V1834, V1835, V1836, V1837, V1838, V1839, V1840, V1841, V1842, V1843, V1844, V1845, V1846, V1847, V1848, V1849, V1850, V1851, V1852, V1853, V1854, V1855, V1856, V1857, V1858, V1859, V1860, V1861, V1862, V1863, V1864, V1865, V1866, V1867, V1868, V1869, V1870, V1871, V1872, V1873, V1874, V1875, V1876, V1877, V1878, V1879, V1880, V1881, V1882, V1883, V1884, V1885, V1886, V1887, V1888, V1889, V1890, V1891, V1892, V1893, V1894, V1895, V1896, V1897, V1898, V1899, V1900, V1901, V1902, V1903, V1904, V1905, V1906, V1907, V1908, V1909, V1910, V1911, V1912, V1913, V1914, V1915, V1916, V1917, V1918, V1919, V1920, V1921, V1922, V1923, V1924, V1925, V1926, V1927, V1928, V1929, V1930, V1931, V1932, V1933, V1934, V1935, V1936, V1937, V1938, V1939, V1940, V1941, V1942, V1943, V1944, V1945, V1946, V1947, V1948, V1949, V1950, V1951, V1952, V1953, V1954, V1955, V1956, V1957, V1958, V1959, V1960, V1961, V1962, V1963, V1964, V1965, V1966, V1967, V1968, V1969, V1970, V1971, V1972, V1973, V1974, V1975, V1976, V1977, V1978, V1979, V1980, V1981, V1982, V1983, V1984, V1985, V1986, V1987, V1988, V1989, V1990, V1991, V1992, V1993, V1994, V1995, V1996, V1997, V1998, V1999, V2000, V2001, V2002, V2003, V2004, V2005, V2006, V2007, V2008, V2009, V2010, V2011, V2012, V2013, V2014, V2015, V2016, V2017, V2018, V2019, V2020, V2021, V2022, V2023, V2024, V2025, V2026, V2027, V2028, V2029, V2030, V2031, V2032, V2033, V2034, V2035, V2036, V2037, V2038, V2039, V2040, V2041, V2042, V2043, V2044, V2045, V2046, V2047, V2048, V2049, V2050, V2051, V2052, V2053, V2054, V2055, V2056, V2057, V2058, V2059, V2060, V2061, V2062, V2063, V2064, V2065, V2066, V2067, V2068, V2069, V2070, V2071, V2072, V2073, V2074, V2075, V2076, V2077, V2078, V2079, V2080, V2081, V2082, V2083, V2084, V2085, V2086, V2087



The schematic diagram illustrates the internal circuitry of the Philips 5550 television receiver. It is divided into several functional sections:

- Power Supply Section:** Features a 230V AC input connected to a 1.5A fuse (F1502). The power is then stepped down by a 150V transformer (T1502) to a 94V secondary. This section includes a 100μF electrolytic filter capacitor (C1514) and a 100kΩ resistor (R1507) for line regulation.
- Tuner Section:** The 94V supply is connected to the tuner (X1507) through a 150kΩ resistor (R1537). The tuner is also connected to a 150kΩ resistor (R1538) and a 100kΩ resistor (R1539).
- Video Amplifier Section:** The video signal is amplified by a BC549C transistor (V1532) and a BC549C transistor (V1533). The output is connected to a 150kΩ resistor (R1534) and a 100kΩ resistor (R1535).
- Audio Amplifier Section:** The audio signal is amplified by a BC549C transistor (V1536) and a BC549C transistor (V1537). The output is connected to a 150kΩ resistor (R1538) and a 100kΩ resistor (R1539).
- Other Components:** The diagram includes various other components such as resistors (R1501, R1502, R1503, R1504, R1505, R1506, R1508, R1509, R1510, R1511, R1512, R1513, R1514, R1515, R1516, R1517, R1518, R1519, R1520, R1521, R1522, R1523, R1524, R1525, R1526, R1527, R1528, R1529, R1530, R1531, R1532, R1533, R1534, R1535, R1536, R1537, R1538, R1539, R1540, R1541, R1542, R1543, R1544, R1545, R1546, R1547, R1548, R1549, R1550, R1551, R1552, R1553, R1554, R1555, R1556, R1557, R1558, R1559, R1560, R1561, R1562, R1563, R1564, R1565, R1566, R1567, R1568, R1569, R1570, R1571, R1572, R1573, R1574, R1575, R1576, R1577, R1578, R1579, R1580, R1581, R1582, R1583, R1584, R1585, R1586, R1587, R1588, R1589, R1590, R1591, R1592, R1593, R1594, R1595, R1596, R1597, R1598, R1599, R1600), capacitors (C1501, C1502, C1503, C1504, C1505, C1506, C1507, C1508, C1509, C1510, C1511, C1512, C1513, C1514, C1515, C1516, C1517, C1518, C1519, C1520, C1521, C1522, C1523, C1524, C1525, C1526, C1527, C1528, C1529, C1530, C1531, C1532, C1533, C1534, C1535, C1536, C1537, C1538, C1539, C1540, C1541, C1542, C1543, C1544, C1545, C1546, C1547, C1548, C1549, C1550, C1551, C1552, C1553, C1554, C1555, C1556, C1557, C1558, C1559, C1560, C1561, C1562, C1563, C1564, C1565, C1566, C1567, C1568, C1569, C1570, C1571, C1572, C1573, C1574, C1575, C1576, C1577, C1578, C1579, C1580, C1581, C1582, C1583, C1584, C1585, C1586, C1587, C1588, C1589, C1590, C1591, C1592, C1593, C1594, C1595, C1596, C1597, C1598, C1599, C1600), and transistors (V1501, V1502, V1503, V1504, V1505, V1506, V1507, V1508, V1509, V1510, V1511, V1512, V1513, V1514, V1515, V1516, V1517, V1518, V1519, V1520, V1521, V1522, V1523, V1524, V1525, V1526, V1527, V1528, V1529, V1530, V1531, V1532, V1533, V1534, V1535, V1536, V1537, V1538, V1539, V1540, V1541, V1542, V1543, V1544, V1545, V1546, V1547, V1548, V1549, V1550, V1551, V1552, V1553, V1554, V1555, V1556, V1557, V1558, V1559, V1560, V1561, V1562, V1563, V1564, V1565, V1566, V1567, V1568, V1569, V1570, V1571, V1572, V1573, V1574, V1575, V1576, V1577, V1578, V1579, V1580, V1581, V1582, V1583, V1584, V1585, V1586, V1587, V1588, V1589, V1590, V1591, V1592, V1593, V1594, V1595, V1596, V1597, V1598, V1599, V1600).

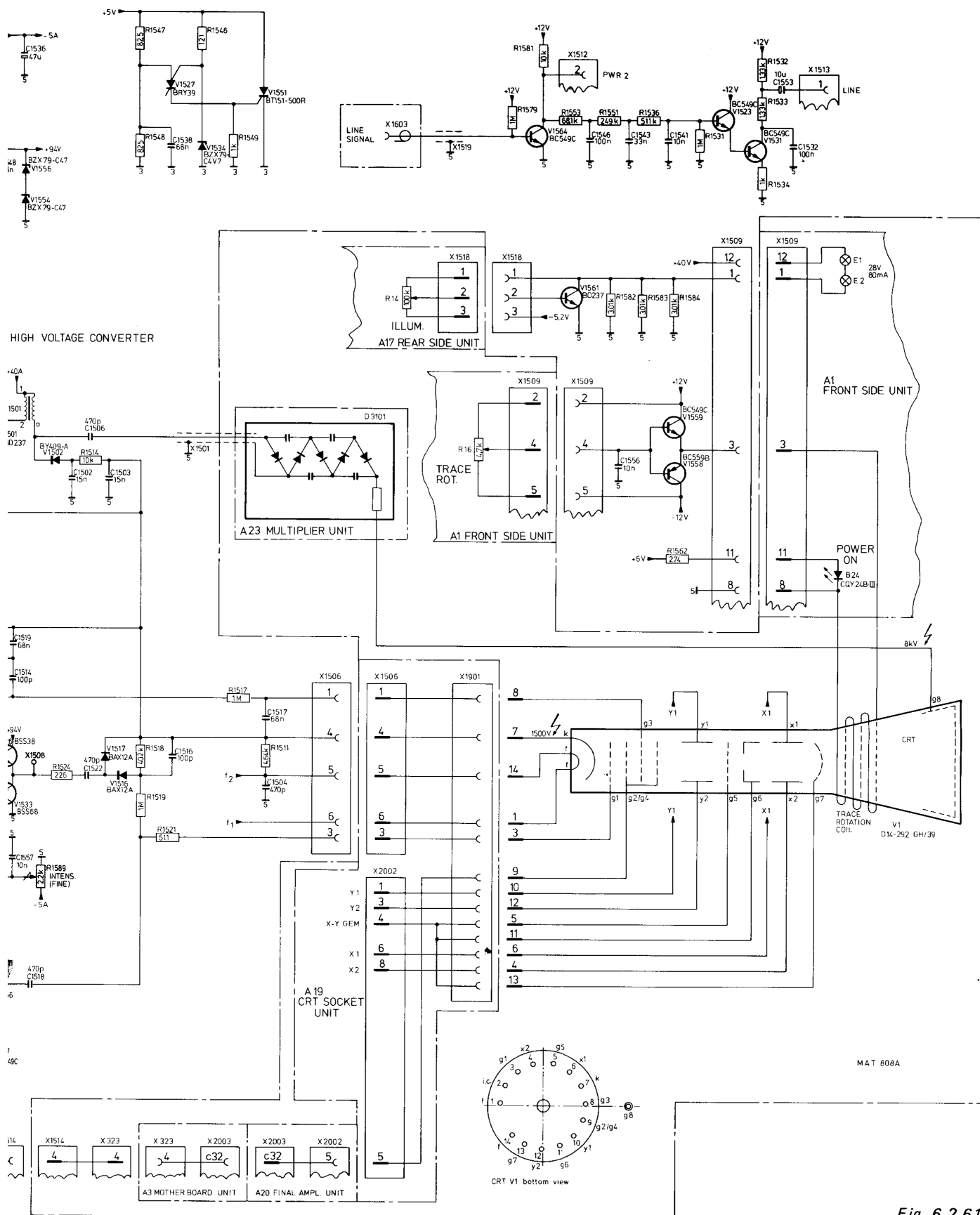


Fig. 6.2.61.

6.2.16. A.C. power unit A16

The A.C. POWER UNIT comprises a bridge rectifier, a d.c. to a.c. converter regulator and a transformer. Rectifier circuits for the different supply voltages are located on D.C. POWER UNIT A15.

Input circuit

The incoming mains voltage is fed via a double-pole POWER ON/OFF switch S40, fuse F1701 (2 A delayed-action) and mains filter D1701 to the mains rectifier circuit.

This mains rectifier circuit can be matched to one out of two input voltage ranges (115 V or 230 V range) with the MAINS ADAPTER SWITCH S45 on the rear panel of the instrument.

The two-position switching enables the instrument to operate at any mains voltage between 100V and 120V $\pm 10\%$ (115 visible in MAINS ADAPTER SWITCH window) and between 220 V and 240 V $\pm 10\%$ (230 V visible in window).

Note: The same 2A delayed-action fuse is applicable for both settings of the mains adaptor switch.

The mains voltage is rectified with the diode bridge V1602 and smoothed by capacitors C1606 and C1604, which form a voltage doubler in the 115 V range of S45 and a standard bridge rectifier circuit in the 230 V range of S45.

The voltage across the series circuit of C1606 and C1604 is 250 V to 400 V for both mains voltage ranges.

Switching circuit

The unregulated d.c. voltage is applied in the form of pulses to a resonant circuit consisting of the primary coil of the converter transformer T1602, combined with C1602 and C1603, via switching transistor V1618.

The sine-wave voltage (approx. 800 V_{p-p}) across the primary coil of T1602 is kept constant by regulating the duty cycle of the base current of V1618.

The primary coil of T1601, which is in series with the switching transistor, limits the current through this transistor.

The energy stored in T1601 is fed back to the mains rectifier circuit, during the cut-off time of V1618, via diode V1601.

Diodes V1608 and V1609 eliminate the dissipation through transistor V1618 during the switching period; instead of this, these losses are dissipated in R1604 and R1603.

Diode V1617 improves the base drive for V1618.

Regulator circuit

The regulator circuit consists of integrated circuit D1601 (type TDA 1060), the output (pin 15) of which supplies a square-wave current with a variable duty-cycle to the base of transistor V1616. The signal on the collector of this transistor is applied to switching transistor V1618 via transformer T1603.

The regulator circuit is controlled by the following:

- Feedback voltage (pin 3)

This is the regulator control voltage derived from the rectifier circuit in the feedback winding of T1602. The value of this control voltage depends on the setting of R1646.

- Feed-forward voltage (pin 16)

This voltage is derived from the mains voltage and provides direct compensation for mains variation.

- Overvoltage protection (pin 13)

A voltage is also derived from the mains voltage, via zener diode V1613, to inhibit the regulator output at excessive mains voltages (the level on pin 13 is 600 mV).

- Current limiting (pin 11)

The voltage drop across the current-sense resistor R1627 controls the regulator circuit in the event of overload.

— Frequency adjustment (pin 7)

The value of resistance between pin 7 and earth determines the converter frequency. Preset R1647 should be adjusted for a frequency of 20 kHz approximately, i.e. the resonant frequency of C1602, C1603 and the primary coil of T1602.

During normal working, the power supply for the regulator circuit is provided by the rectifier connected to the feedback winding of T1602. Transistor V1622 then conducts, therefore V1621 does not give any current output.

Switching-on and switch-on protection

At the moment of switching-on the instrument, no supply voltages are immediately available in the regulator circuit from T1602. Transistor V1622 is not yet conducting, therefore transistor V1621 is fully conducting and the regulator derives its current via R1616 and R1631. As soon as the converter circuit is working, transistor V1622 conducts and V1621 blocks.

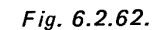
In the event of the instrument giving no converter voltage at switch-on (due to a possible defect), the PTC resistor R1631 warms up and so reduces the current through transistor V1621 to a safe level.

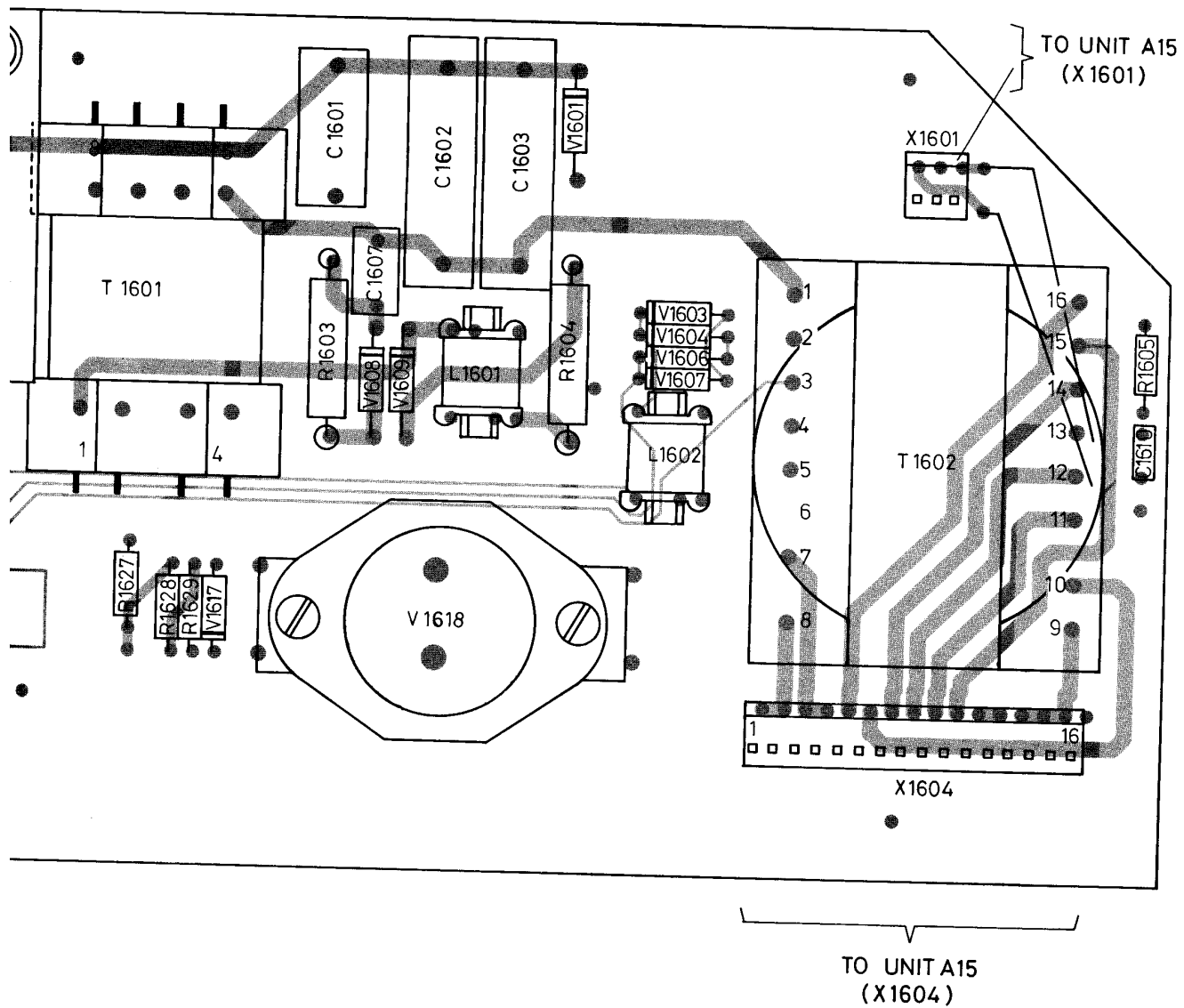
Output circuits

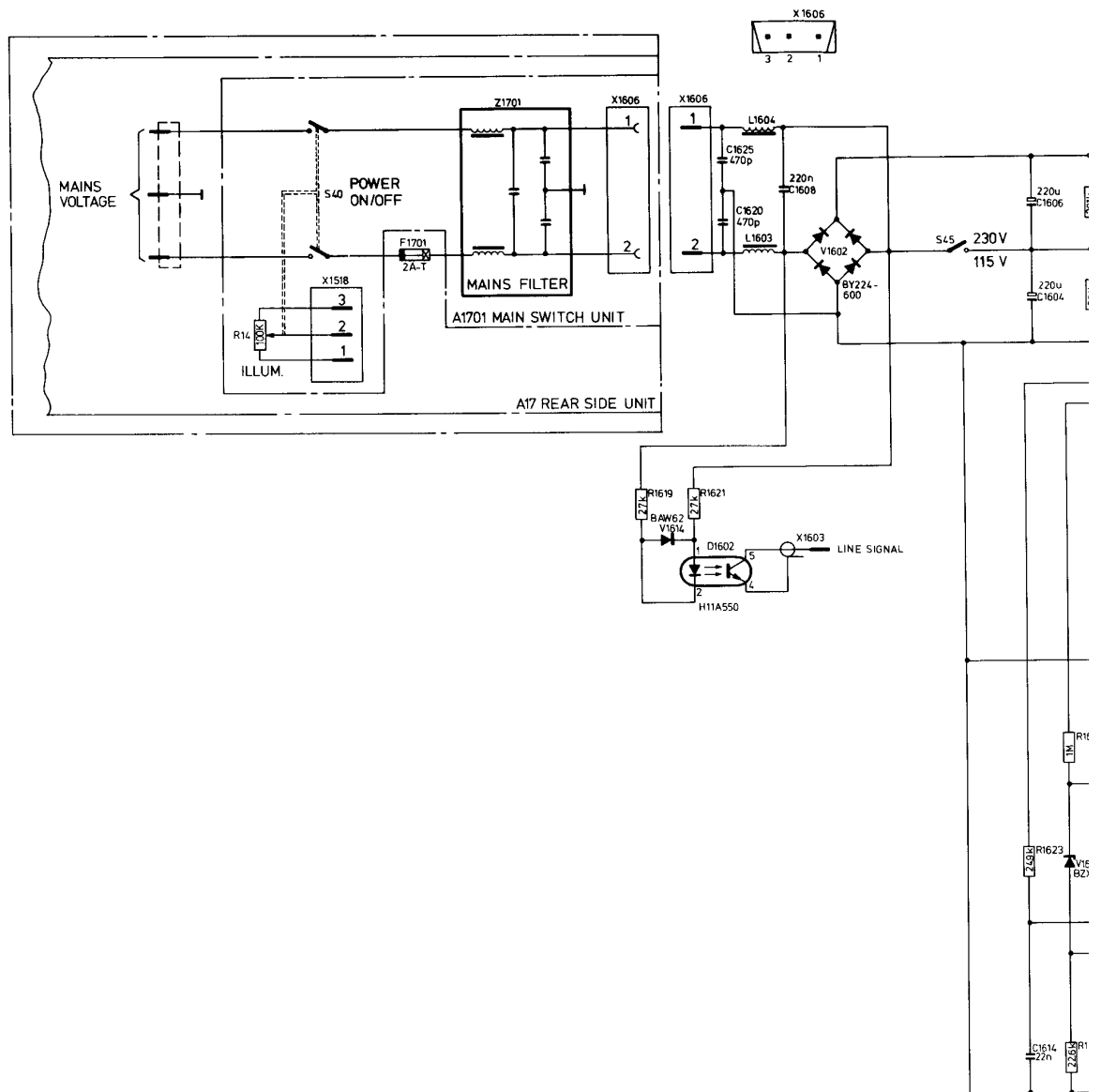
Various supply voltages are derived from the secondary windings of transformer T1602. These supplies are generated on D.C. POWER UNIT A15.

Photocoupler circuit

To enable triggering on a mains signal, this circuit produces a signal derived from the mains voltage. Photocoupler D1602 provides isolation between the mains voltage and the oscilloscope circuits to produce a safe triggering signal. This output signal is applied to transistor V1564 on unit A15, which is driven into saturation to give a square-wave voltage on its collector. This square-wave has a constant amplitude for all mains voltages.







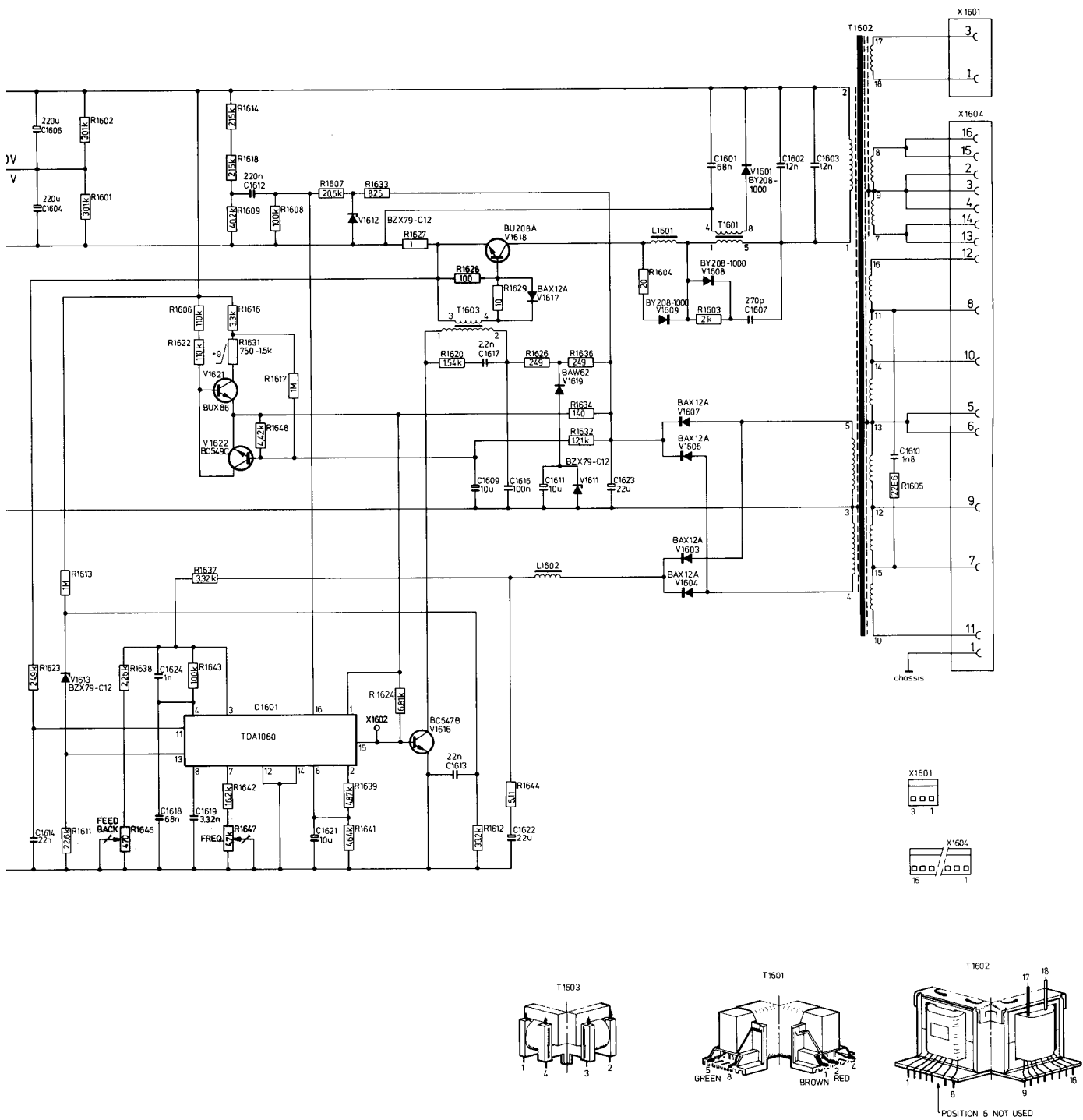


Fig. 6.2.63.