FLUKE®

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601PRO Series$_{XL}$

International Safety Analyzer
Service Manual

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Notices

Fluke Biomedical
A Division of Fluke
6920 Seaway Blvd.
Everett, WA 98203 USA

Customer Service and Sales

USA and Canada:	800.648.7952
Outside the USA:	775.883.3400
Sales E-Mail:	sales@flukebiomedical.com
Internet:	www.flukebiomedical.com
Service:	888.993.5853
Outside the USA:	425.446.5560

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Manufacturing Location

Fluke Biomedical
6920 Seaway Blvd
Everett, WA. 98203 USA.
775-883-3400
800-648-7952

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Table of Contents

Chapter 1
General Information

This chapter presents the purpose and scope of this manual.

Purpose and Scope

The purpose of this manual is to provide information that will enable a technician to service the *601PRO Series$_{XL}$*. Previous versions of the 601PRO are not described in this manual. The instrument is available with the following configurations. This manual provides a detailed description of the ISA601PROXLUSP.

Language Overlay	Printer	Circuit Breaker	Outlet & Line Cord	P/N
German	Yes	15A	Schuko	2250345
German	No	15A	Schuko	2250338
English	Yes	15A	Schuko	2250323
English	No	15A	Schuko	2250314
English	Yes	15A	Nema	2250389
English	No	15A	Nema	2250377
English	Yes	10A	Australian	2250306
English	No	10A	Australian	2250306
English	Yes	15A	UK	2250361
English	No	15A	UK	2250350

Abbreviations and Symbols

This section describes the safety symbols used within the manual.

The following warning and informational symbols may be found in various locations on the *601PRO*. Only qualified personnel who recognize shock hazards and are familiar with the safety precautions should use this instrument. Read the manual carefully before operating this instrument.

Alternating current
Courant alternatif
Dreiphasen-Wechselstrom
Corriente Atterna
Corrente alternata

Direct current
Courant continue
Gleichstrom
Corriente continua
Corrente continua

Both direct and alternating current
Courant continu et courant alternatif
Allstrom (Gleich - und Wechselstrom)
Corriente continua y corriente alterna
Corrente continua e corrente alternata

Earth ground terminal
Borne de terre
Erde (Bettriebserde)
Borne de Tierra
Terra (di funzionamento)

Protective conductor terminal
Borne de terre de protection
Schutzleiteranscluss
Borne de Tierra de Protección
Terra di protezione

On (Supply)
Marche (alimentation)
Ein (Verbindung mit dem Netz)
Connectado
Chiuso

Off (Supply)
Arrest (alimentation)
Aus (Trennung vom Netz)
Desconectado
Aperto (sconnessione dalla rete di alimentazione)

Caution (refer to accompanying documents)
Attention (voir documents d'accompanement)
Achtung siehe Begleitpapiere
Atención (vease los documentos incluidos)
Attenzione, consultare la doc annessa

Caution, risk of electric shock
Attention, risque de choc electrique
Gefährliche elektrische Spannung
Atención, riesgo de sacudida eléctrica
Alta tensione (in questo documento Alta tensione non significa “tensione pericolosa” come definito in IEC 417)

Relationship of This Manual to Other Publications

This document does not contain a description of operating controls or operating instructions. The reader should refer to the Operator's Manual (Fluke Biomedical part number 2234222) for this information.

Equipment Description

The 601PRO Series$_{XL}$ International Safety Analyzer is an automated electrical safety analyzer that meets international standards for electrical safety testing of hospital electromechanical equipment.

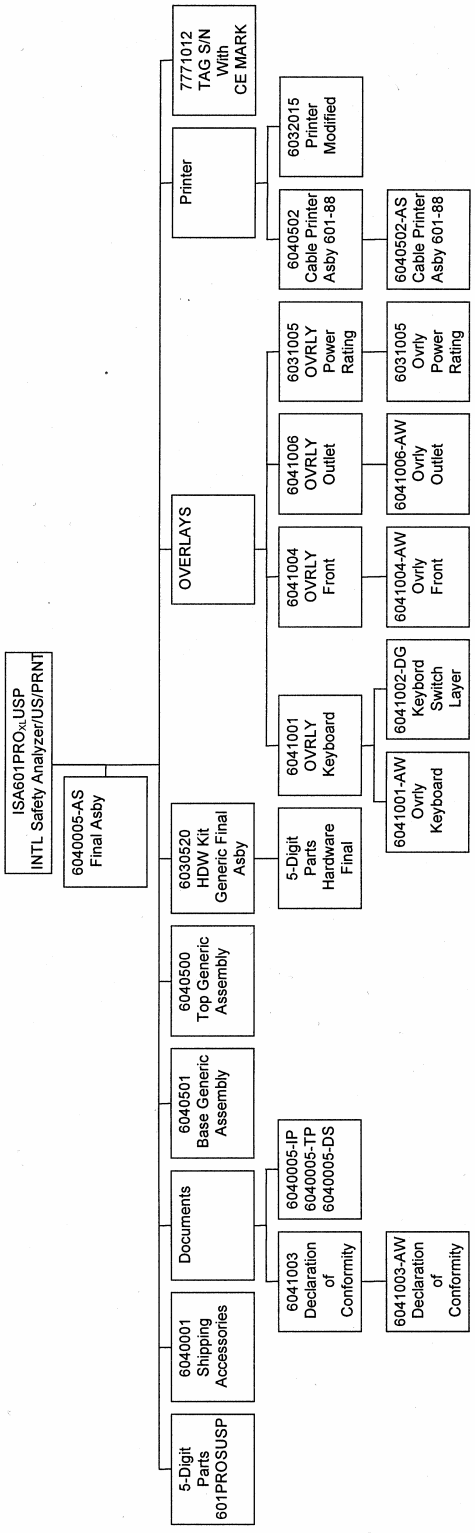
The 601PRO Series$_{XL}$ conducts electrical safety testing in accordance with IEC 601-1, VDE 751.1, VDE 701, IEC 1010, AAMI and HEI-95 requirements, flags failures, and simulates performance, ECG, and arrhythmia wave forms. Test results, which are automatically analyzed and saved in non-volatile memory, can be printed using the internal ZY column thermal printer, an attached external printer, or transferred to a PC via the serial port.

The 601PRO Series$_{XL}$ offers automatic, manual, or step-mode operation. Manual mode allows any specific test to be performed continuously. Serial operation is also provided.

The 601PRO Series$_{XL}$ will accept input from an external keyboard, integrated keyboard, keyboard barcode wedge, or an external RS232 device.

Equipment Relationship Illustration

ISA601PRO$_{XL}$USP



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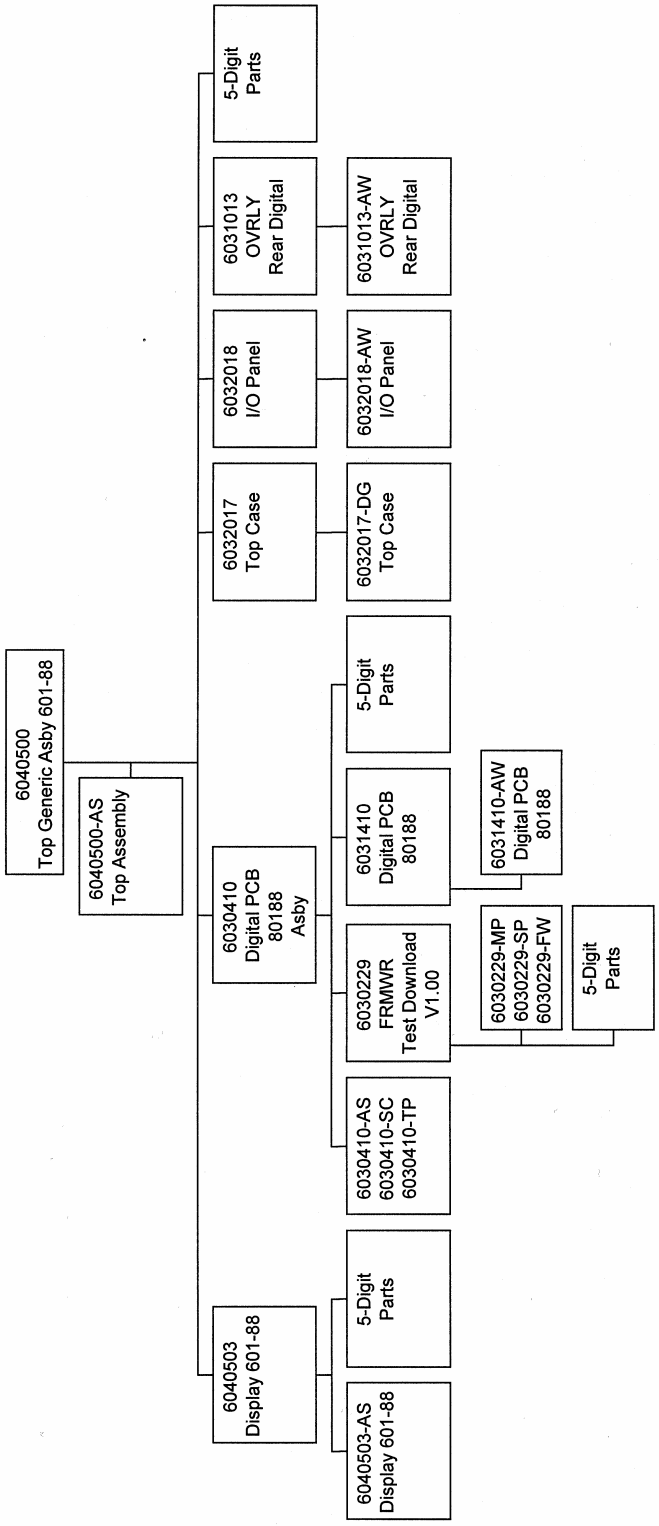
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Top Generic Asby 601-88
6040500-AS
Top Assembly
6040503
Display 601-88
6040503-AS
Display 601-88
5-Digit
Parts
6030410
Digital PCB
80188
Asby
6030410-AS
6030410-SC
6030410-TP
6030229
FRMWR
Test Download
V1.00
6030229-MP
6030229-SP
6030229-FW
5-Digit
Parts
6031410
Digital PCB
80188
6031410-AW
Digital PCB
80188
5-Digit
Parts
6032017
Top Case
6032017-DG
Top Case
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I/O Panel
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I/O Panel
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Rear Digital
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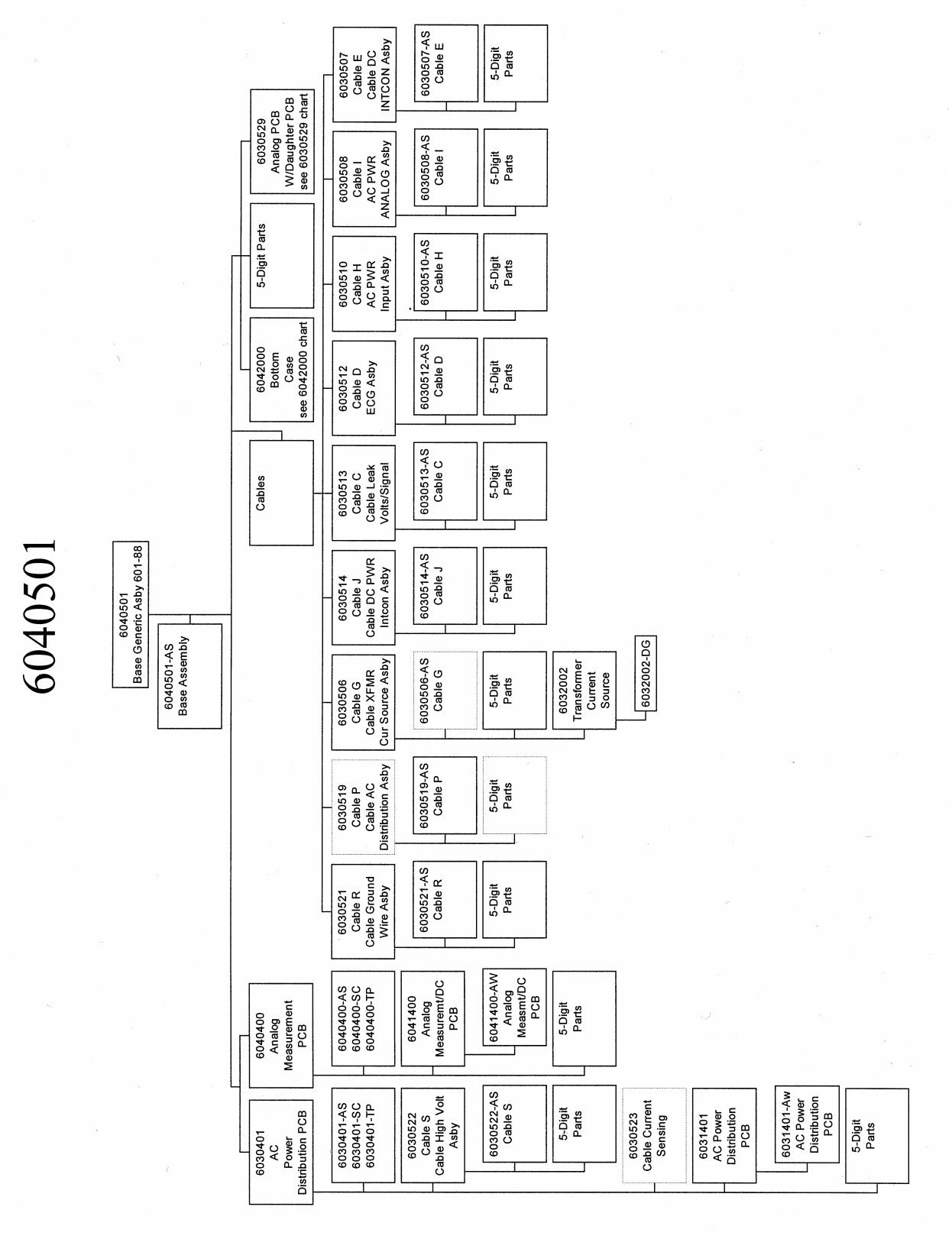
OVRLY
Rear Digital
5-Digit
Parts


6040501
6040501
Base Generic Asby 601-88
6040501-AS
Base Assembly
Cables
6042000
Bottom
Case
see 6042000 chart
5-Digit Parts
6030529
Analog PCB
W/Daughter PCB
see 6030529 chart
6030507
Cable E
Cable DC
INTCON Asby
6030507-AS
Cable E
5-Digit
Parts
6030508
Cable I
AC PWR
ANALOG Asby
6030508-AS
Cable I
5-Digit
Parts
6030510
Cable H
AC PWR
Input Asby
6030510-AS
Cable H
5-Digit
Parts
6030512
Cable D
ECG Asby
6030512-AS
Cable D
5-Digit
Parts
6030513
Cable C
Cable Leak
Volts/Signal
6030513-AS
Cable C
5-Digit
Parts
6030514
Cable J
Cable DC PWR
Intcon Asby
6030514-AS
Cable J
5-Digit
Parts
6030506
Cable G
Cable XFMR
Cur Source Asby
6030506-AS
Cable G
5-Digit
Parts
6032002
Transformer
Current
Source
6032002-DG
6030519
Cable P
Cable AC
Distribution Asby
6030519-AS
Cable P
5-Digit
Parts
6030521
Cable R
Cable Ground
Wire Asby
6030521-AS
Cable R
5-Digit
Parts
6030401
AC
Power
Distribution PCB
6040400
Analog
Measurement
PCB
6040400-AS
6040400-SC
6040400-TP
6041400
Analog
Measrmt/DC
PCB
6041400-AW
Analog
Measmt/DC
PCB
5-Digit
Parts
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6030401-SC
6030401-TP
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Cable S
Cable High Volt
Asby
6030522-AS
Cable S
5-Digit
Parts
6030523
Cable Current
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AC Power
Distribution
PCB
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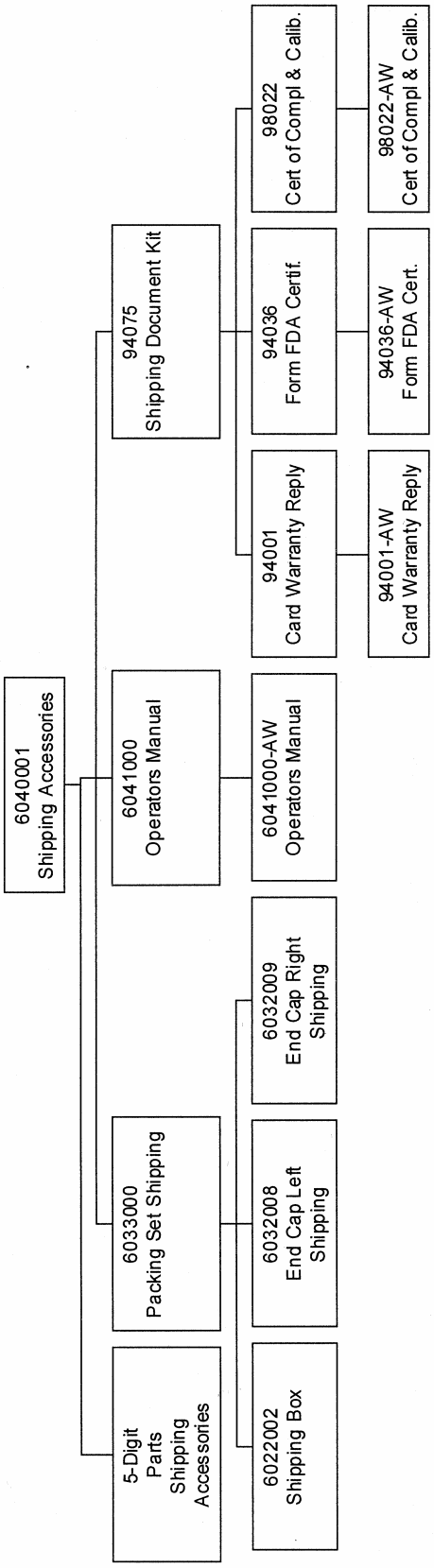
Distribution
PCB
5-Digit
Parts

6040001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End Cap Right
Shipping
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6041000-AW
Operators Manual
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Shipping Document Kit
94001
Card Warranty Reply
94001-AW
Card Warranty Reply
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Form FDA Cert.
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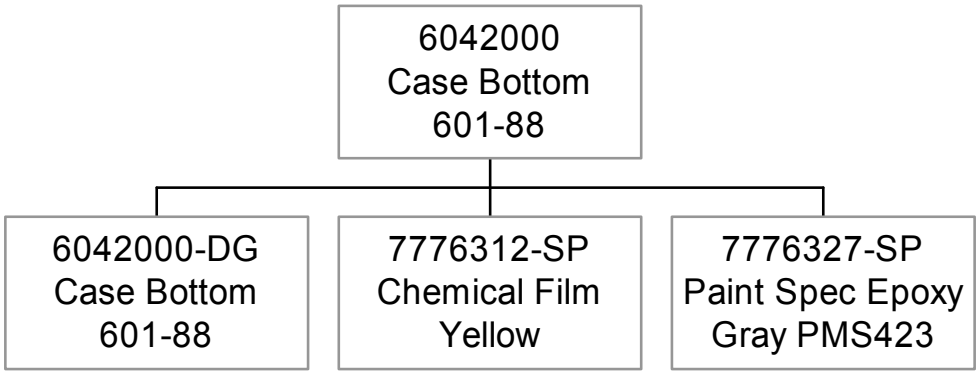
98022-AW
Cert of Compl & Calib.

6042000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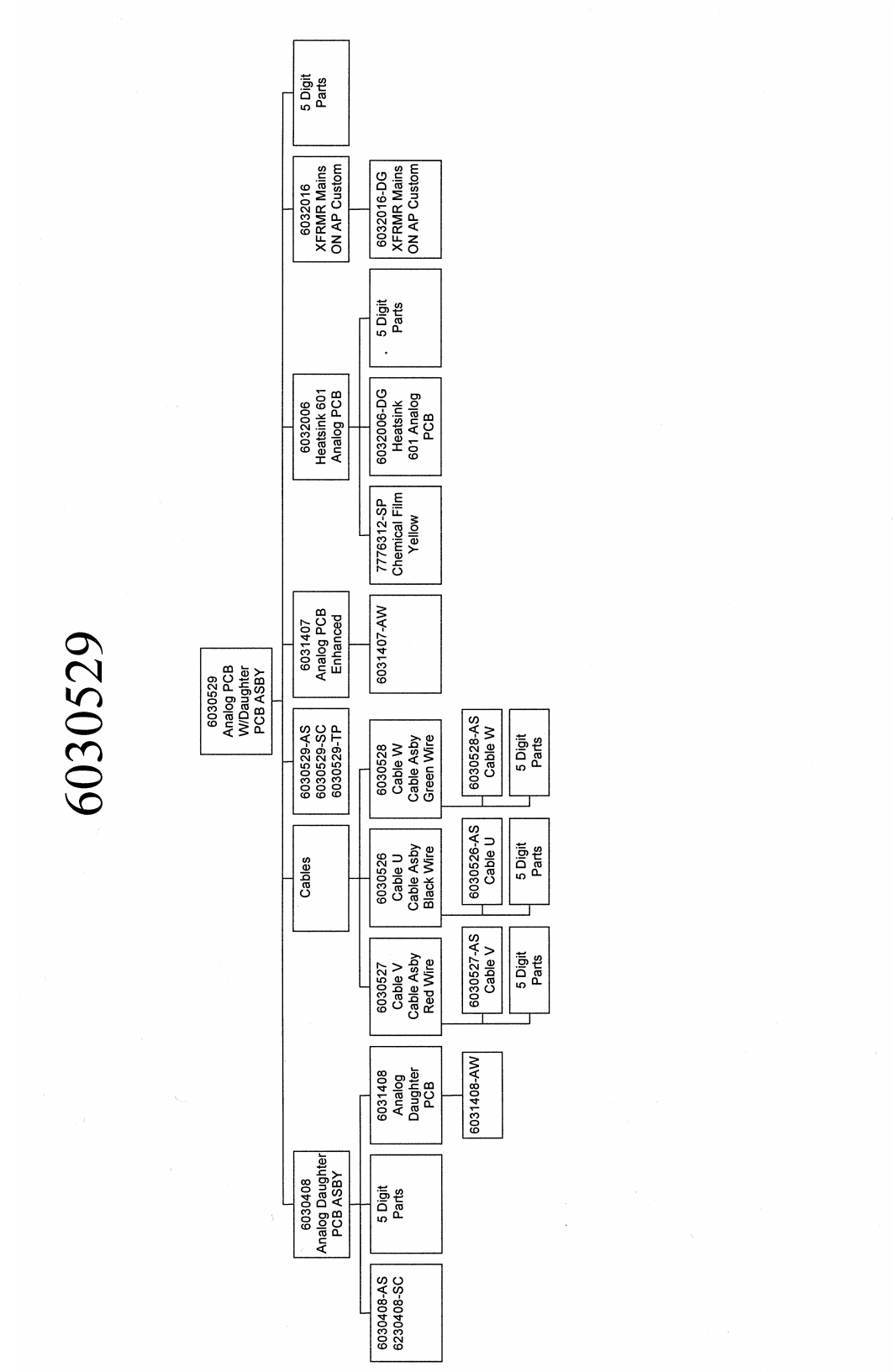
601-88
6042000-DG
Case Bottom
601-88
7776312-SP
Chemical Film
Yellow
7776327-SP
Paint Spec Epoxy
Gray PMS423


6030529
6030529 Analog PCB W/Daughter PCB ASBY
6030408 Analog Daughter PCB ASBY
6030408-AS 6230408-SC
5 Digit Parts
6031408 Analog Daughter PCB
6031408-AW
Cables
6030527 Cable V Cable Asby Red Wire
6030527-AS Cable V
5 Digit Parts
6030526 Cable U Cable Asby Black Wire
6030526-AS Cable U
5 Digit Parts
6030529-AS 6030529-SC 6030529-TP
6030528 Cable W Cable Asby Green Wire
6030528-AS Cable W
5 Digit Parts
6031407 Analog PCB Enhanced
6031407-AW
6032006 Heatsink 601 Analog PCB
7776312-SP Chemical Film Yellow
6032006-DG Heatsink 601 Analog PCB
5 Digit Parts
6032016 XFRMR Mains ON AP Custom
6032016-DG XFRMR Mains ON AP Custom
5 Digit Parts

Chapter 2
Functional Description

This chapter provides information to support troubleshooting and equipment maintenance.

Theory of Operation

This chapter includes the theory of operation. All of the major and supporting functions (e.g., power and control) of the 601PRO Series$_{XL}$ are described herein.

Circuit Description

The 601PRO Series$_{XL}$ contains a new digital assembly and a modified measurement assembly. The digital assembly uses a newer and more powerful microprocessor (Intel 80C188EB) and replaces the battery backed Static RAM with Flash RAM that does not require battery power for nonvolatile memory. A low pass filter has been added to the measurement assembly for the DC only function. Additional adjustments have been added to the measurement assembly to accommodate a less expensive instrumentation amplifier. The Digital PCB Assembly used in the 601PRO Series$_{XL}$, has been assigned a new part number (2075814). The AC Power Switching PCB Assembly and the large Analog PCB assembly are unchanged from the previous version of the 601PRO Series.

Input Power

The 601PRO Series$_{XL}$ is externally powered by AC line voltage and will operate from 80 to 145 and from 170 to 270VAC (50-60Hz) IEC use is defined from 90-132 and 180-240VAC. The 601PRO Series$_{XL}$ makes a voltage measurement when it is turned on, and determines the mains voltage, and sets the primary of the Protective earth Current transformer accordingly. Also, this voltage measurement adjusts calibration factors for various tests (such as Mains on applied parts, and VDE tests.) If the 601PRO Series$_{XL}$ is being used with an adjustable input mains voltage (such as a variac), the 601PRO Series$_{XL}$ should be turned off, the voltage adjusted and then turned on, (cycle power off then on, if a significant adjustment of mains voltage is made.) The 601PRO's accuracy is affected or the unit could be damaged (i.e. 120VAC at turn on, and changed to 240VAC) if the mains voltage is altered after power on. There are no user replaceable fuses. There is a circuit breaker incorporated into the power switch on the front of the unit. Further non user accessible circuit protection is accomplished internally by using PTC resistors.

Internal Power Supplies

The 601PRO Series$_{XL}$ has a universal input power module providing +/-12VDC and +5 VDC; a power supply for providing 6VAC max at no load, and up to 24amps for earth resistance measurement (which uses 2 12VDC-12VDC converters for control isolation); and 12VDC to 500VDC power supplies for the 500VDC insulation resistance test; a 12VDC to +/-15VDC converter is an isolated supply for the floating measurement front end; and 110% of mains supply; and a battery for the real time clock.

+/-12 Volts, 5 Volts

NOTE: The line voltage from 80VAC to 270VAC, 50 or 60Hz, is connected to a universal input power module, which in turn provides the control and measurement power supplies as follows:

1) +5VDC is the logic supply voltage; and provides power to the LED display backlight.
2) +12VDC provides power to the relays, and several dc to dc converters, used for isolation in the measurement front end, and the protective earth resistance circuit, and the 500VDC insulation resistance test.
3) -12 VDC to the ecg amplifier.
   FB1,2,3 provide noise isolation between supplies shown on Analog schematic-SC, page 1, and 6030401-SC, page 1 (FB1).

VCC +5 Logic Voltage

This is the logic power for instrument. In addition, it is used for RS232 +/- supply, via U4 (MAX208E) on 6030410-SC page 1, and also to generate -(minus) 5VDC via U17 (7662A) voltage converter on 6030410-SC sheet 3 for the D/A converter that generates ECG signals. The +5 logic voltage monitored by U2 on 6030410-SC page 1 and will reset the microprocessor if the power supply voltage drops below 4.25 to 4.50 volts DC. The clock chip, U3 has its own 3Volt lithium battery BT1.

+ 12VDC Relay Power

Relays are powered by 12VDC. The smaller signal relays are controlled primarily by Sprague UCN5841 relay driver IC's on Analog schematic page 1 (U21 through 26). The larger relays are controlled by a parallel latched output port on 6030410-SC page 6 (U28,29) on to 6030401 page 1 of 1, power switching board via opto isolators U1,2,3 and relay drivers U4 and U5.

+ and - 12Volts

This is used on:

- 6030529-SC page 4 shows an isolated supply from U7, a 12VDC to 12VDC converter and also U11, a 12VDC to +/-12VDC isolated supply, both used (Analog PCB pages 4 and 5) in the protective earth 25/1 Amp current source circuit (U4,5,6,7,8,9,10,11,12,13,14,15,PTC 3,4,5, 9,Q5,Q10,Q11, 17,etc.)
- +12VDC to 500VDC isolated supply, controlled by (Q1,2, U1) on Analog schematic p 3.
- +12VDC to +/-15VDC isolated supply which powers the floating measurement front end
  6040410 p1, 12.
- -12VDC is used to power the ECG differential amplifier Analog schematic p1, U17 and Current transformer measurement amplifier, U3.

Mains Voltage Selection Relay (Software Controlled)

After measuring the mains voltage at power on, if the voltage is in the proper operating range (see preceding section), RY 40 is set to the proper primary voltage on the earth continuity transformer Analog schematic p 2.

The Protective Earth Continuity Current Source

The circuitry shown on Analog schematic p 4 and p 5 is a regulated current source. It is supplied by the large transformer connected through J5 and J6 shown on Analog schematic page 4. The 601PRO Series$_{XL}$ measures the mains voltage at power up, and energizes RY40(p2) if the voltage is below 145 VAC, to provide the proper primary voltage to this transformer. The primary of this transformer is selected to use the 230VAC series winding connection if RY 40 is left normally open, or if energized, 115 volt parallel primary windings. The resistance (ohms) displayed in this test is the resistance which is connected between the red lead and Device Under Test (DUT) ground. The displayed resistance is the voltage from the red lead to DUT ground connection, divided by the current flowing out of the red lead (the DUT ground and the green jack on the front panel are internally wired together). The resistance calibration allows the user to subtract the resistance of the test leads.

The following is the circuit description: briefly: the big transformer can provide around 10VAC at 24AMPS. The test current is determined by measuring the AC voltage across .01 ohms in series with the test current. This voltage goes to an RMS to DC converter which again represents the amount of test current, which is compared to a precision DC reference, and this comparison determines the amount of drive on the FETs which control the amount of current which flows from the big transformer. To make sure the voltage doesn't get to high when little current is flowing, the Voltage from the transformer is monitored, and the drive to the FETs is reduced (clamped). If the FETs get too hot, a thermal switch opens the current path via two series relays, K52 and K51.

Details of the Protective Earth Current Source Circuit

Note:

In addition, the following applies:

1) Additional series resistance used for the 1 amp measurements (R28A&B and PTC6),
2) Gain changes to accommodate the different R's (via R55)
3) Changes in VSCYCLE detection by filtering the inductive kick right after the zero cross point. This allows measurement of grounds with inductance up to 500mH. This is done via a small add on board: 6030408.

The Circuit Description

U12 and U9 provide precision +/- 5 (labeled 5VA and -5VA) volts reference shown on Analog schematic p 4. (This is derived from the isolated 12 volt supply, hence is isolated from the line. The largest transformer in the unit is controlled to provide about 6VAC and 24 Amps, or 1 amp. The current control is done via a feedback loop made by the current measured by R45,46,47,48 and U15 on Analog schematic p 4, and RMS converterU13 (p5). This is compared and controlled by the components on page 5, ultimately back to POSFET and NEGFET signals on page 4 to Q5 and Q11. When 24 amps of current flows through R45,46,47,48 it produces .24 volts, which is scaled at U15 programmable gain instrumentation amplifier, set for times 1 (or times 24 if 1 amp testing) via K50. (The same control mechanism is used for either 1 amp or 24 amps test current, however, the 1 amp test has additional current limiting resistance switched into the circuit.) U13 is an RMS to DC converter, which takes the ac voltage output from U15 (A voltage representing the current flowing through the red lead to DUT earth, [scaled up times 24 if using the 1 amp range]), and converts it to DC at U13 pin 6. This voltage, through R44 (12K), is

compared to the reference voltage formed by R42 (499K resistor) from the -5VA at U9. The current for the positive and negative cycle are controlled by separate FETS, but the total positive and negative phase current is summed by the RMS to DC converter. The phase is determined by U4 (output on pin 1) on page 4, which creates signal VSCYCLE. This signal is rectified by U4 (output on p14) and D1 and D3 to produce the control for the POSFET. U4 output on pin 7 is an inverter, and U4 (output on pin 8) and D2 and D4 produce the Negative FET control signal gate NEGFET.

Let's follow the control path of the positive half of the cycle. U6 pins 5 and 6 are compared to allow only drive when needed on the positive half of the voltage. A negative voltage output (pin 7) here would be a request for more current in the loop, on this positive half cycle (from the Protective earth resistance transformer). U6 pin 7 Analog schematic p 5) is connected to optoisolator U10 (Analog schematic p 4) to Q9 and Q5, driven by pull-ups RN 3 to +12VF. +12VF is a dedicated, isolated supply for the protective earth FET drive circuit. In the same way, the negative half of the cycle is controlled via U6 pin 2 and 3 to pin 1, and through the other side U10 (dual optoisolator) to RN3 and Q10 and Q11.

In order to make sure the output voltage doesn't get too high, the output drive voltage is sensed, and when too high, the drive to loop is clamped. This happens at U5 and the output of U8. (In the latest version of analog assembly 2233791 U8 is replaced with daughter board 2233534. The circuit is functionally the same but some additional filtering, and a little delaying of the zero cross point avoids noise caused by inductive components at the zero crossover point.) The clamping action occurs by driving U9 pin 2 high to clamp off the current comparator U9, and thus cause a reduction in drive voltage to the FETs by raising POSFET and NEGFET signal levels (they are analog and more active low), which shuts down current to the protective earth circuit.

Software Notes

- The measurement range for 1 Amp and 25 Amps is 0-2.999 ohms. Over-range for both is 10 Ohms. Maximum calibration limit for lead calibration is 0.150 ohms.
- The manual test will prompt the user to calibrate the leads, if a negative ohm reading is made (a low ohms reading, with a larger ohms cal value). The auto/step test assumes the user has done a lead cal, prior to running the auto/step test, but if an invalid lead calibration value is in memory, when the protective earth test is run, it will display an error saying the leads need calibrating.

The 500VDC Supply

Located on the analog board schematic Analog schematic sheet 3. U1 is an isolated 12 VDC to 500VDC supply for insulation resistance testing. The 500VDC is turned on by driving IRY39 active low. Q2 is an inverter which drives Q1 which in turns U1 on or off. This arrangement makes sure that the 500VDC supply is off when the 601PRO Series$_{XL}$ turns on, since the relay drivers are inactive high (12VDC) at turn on (Q2 turns on, turning Q1 off, and keeping U1 off). The 500VDC supply output drives two caps and R4 (which is a 158K bleeder resistor). One side of R4 goes to R5 (2.49Meg resistor) which is in series with the Protective earth, and R3 (2.49Meg resistor) is in series with test load. This serves to limit the current (and shock potential.).

The Isolated 110% of Mains Power Source

The Isolated 110% of Mains Power Source is Supplied by XT1, which is located on the analog board schematic sheet 2. It is an isolation transformer used for mains on applied part testing, and VDE equivalent device and equivalent patient leakage tests. The power to the primary is protected on the pcb by a PTC resistor (F1) Power to the primary is turned off and on by IRY25 (active low) to U2 and FETs, Q3 and Q4. U2 is an opto-isolated, photvoltaic driver. IRY18 (active low) is applied to K7, which is used to reverse the polarity (phase) of the applied ac voltage. A fixed load resistor R6, combined with the transformer windings and core, act to limit the current. An additional winding on XT1 (and other parts) are used to offset internal capacitive leakages. The “other parts” (which control the amount of leakage) are K55, K56 and C78, 79, 80, & 81.

Floating Power Supply

The ability to make floating measurements comes from U12, an isolated 12VDC to +/- 15VDC converter and Q1, 5V regulator found on the measurement board schematic 6030410 sheet1. The I denotes isolated supplies.

DC Only

The DC only feature consists of a low pass filter on the Measurement PCB Assembly (6040400-SC p2) that can be switched into the leakage channel for DC Only measurements. The 4-pole RC filter (R37..R40 & C38.. C41) is placed in or out of the circuit with relays K10 and K11. A bi-directional transient suppresser across the input to the filter limits the voltage to protect the capacitors.

Measurement Front End Isolation

Refer to 6040400-SC measurement board p1. There are 7 dual opto-isolators U2,3,4,5,6,7 which have their internal LED’s powered through RN1 by filtered digital 5 Volts (+5DFM). The output of the opto-isolators are powered by the isolated 5 Volts (5I) on the floating front end, and RN2 is used to pull up the signals to +5I. (6030410 p5) U20 & p6 U27 are the source for the CPU controlled signals for the measurement front end Gain Control, and A/D control and data transfer.

CPU and Support Circuitry

The microprocessor is an Intel 80C188EB (U1) with a 32MHz clock input (Y1). This processor uses and 8-bit external data bus and can directly address 1Mbyte of memory through external address latches (U11, U12). A separate I/O space is decoded by U8. All memory runs with 0 wait states. I/O wait states are listed on the schematic.

Memory

The memory types, and sizes are shown on page 4 of 6030410-SC. Although it is under program control (the microprocessor can dynamically change the memory chip select address decoding), the EPROM is generally at the top (32K) of the 1Mbyte address range. The Static RAM is at the bottom (32K) of the address range, and the remaining portions are occupied by flash memory. The flash memory is used to hold the program code, including language strings as well as test results and device information. The EPROM contains a test program for the digital board (access with dip switch #1 but only when the board is on the digital board test station) and a program for downloading the rest of the code from a computer via the serial port. Downloading must be done with the Fluke Biomedical program intended for this purpose. This program also allows the operator to select the language file to use. Upon power up, the EPROM code checks for the presence of a valid program (by calculating a checksum and comparing it with a stored value. If no program is present, the download mode is entered. Alternatively, to force a download (of a new version for example) pressing the "Previous" key within the first three seconds will also force entry to the download mode. If the download mode is entered, but a

download is not desired, powering down the unit will not cause a loss of any data. The boundary between program memory and nonvolatile data memory is not necessarily split into the two flash ICs, but generally, the lower half of memory (U7) contains program memory, and the upper half of memory (U18) contains nonvolatile data.

Display

Refer to 6030410-SC sheet 5 to see the connections (J5) to the display module. The display is an 4 line by 40 character LCD display with and LED backlight, It has separate control lines for the upper 2 lines and the lower 2 lines of the display. 8 bit characters are sent to the display. The display module handles the bit manipulation required to get the correct pixels displayed. The backlight current is approximately 415mA. The display contrast is adjusted by RT2 (which is a 2K potentiometer which adjusts from 0 to about 1.5VDC.) All are found on 6030410 page 5**.**

I/O Ports

Relay Control Ports

Control for RY1 through RY55 originate from the CPU on 6030410 p6 controlling the parallel outputs of U26 and U28. These signals are inverted and buffered by U27 and U29, then pass through a noise filter (so relay transients can't upset the digital board). The RY1 through RY 48 control is performed through serial control signals RYDATA, RYCLOCK, RYSTRB, and RYENB. These signals are found on the analog board Analog schematic, p 1, connected to the relay drivers: U24,23,22,25,26,22. Note that the RYDATA goes only to SDIN of U24 pin 3, and the SDOUT of U24 pin 6 goes to SDIN of U23 pin 3, etc. through U22, U25, U26, U21. U24 controls RY1 through RY7, U23 controls RY8 through RY15, U22 controls RY16 through RY23, U23 controls RY8 through RY15, U25 controls RY24 through RY31, U26 controls RY32 through RY39, U22 controls RY40 through RY47. Each time one or several relays need to be changed, the Microprocessor serially sets the proper bits for the 6 serially connected relay drivers which in puts all 48 relays at the proper on or off state. This allows 4 signal lines to control up to 48 relays. IRY46 and IRY47 select the amount of current needed to zero the mains on applied parts leakage measurement. During mains on applied parts and some VDE tests, IRY47 applies this corrective current into the LEAK+ front end measurement input, and IRY46 is closed for additional corrective current to zero the front end at 177VAC and above.

Referring to the power switching board, 6030401 p 1, U1,2,3,4 and 5 for RY49 through RY55, which are the heavy duty relays which control the mains connection to the DUT. (As explained in the previous paragraph, these 5 relays are directly controlled by the CPU writing an 8 bit pattern 6030410 p6, U28 [1=on, 0 = off]). The power switching board puts these 5 relay signals through optoisolators, and 2 relay drivers (needed to make sure power up starts without turning on the outlet of the 601PRO).

As an example, we will describe turning on RY40, which sets the primary voltage to the Protective earth resistance transformer. (Note the exact high and low levels may not be totally accurate, however this is written to describe the mechanism for turning the relays to the proper state.) The CPU had accomplished this by writing an 8 bit pattern to the latch U26, the lowest 4 bits are used for serial control of the 48 relays. the strobe (bit2) is brought high to enable the relay drivers U21 through U 28 to accept the serial pulses, and bit 2 is held high while in the next write from the CPU, the RYDATA (bit0) is set low for turning the 48th relay off. Next the CPU leaves bit 0 and bit 2 the same and toggles the clock line high, then in the next write, low. Then the RYDATA (bit0) is set high (or low) to turn the 47th relay on or off, then the RYCLOCK is toggled again. After repeating this operation, through RY40, the next write will cause the state of RY47 to go into the next relay drivers SDIN on U23.....etc. until all 48 relay states are setting in all 6 relay driver chips. Then the RYSTROBE is set low, and the relay outputs are driven to the proper state. RY40 is driven on or off (the relay driver chip has built in flyback diodes to suppress transients from the relay turning off.

Printer and Serial Ports

6030410 page 2 shows connections for the two printers the serial port and the external keyboard connections.

Printer Ports

See 6030410 page 2. The internal 24 column thermal printer is connected to P5. Outgoing characters are latched at U31, (it has a parallel connection), with a busy line monitored as an input, read at U21 pin 19, (6030410 p5). The external printer is connected to P3 (25 pin D female D-subminiature). Outgoing characters are latched at U30 (page 2), a BUSY, PRINTER (printer connected and powered) and ONLINE signal inputs, read at U21 port C (page 5).

Serial Ports

The 601PRO Series$_{XL}$ conforms to the Fluke Biomedical Serial Interface Standard (R&D OP11), which should be referred to for more information. The 601PRO Series$_{XL}$ has one, 9 pin serial port located on the rear panel of the instrument. on The female 9-pin D sub-miniature serial connector (P2) is a serial port, DTE configuration.

Input Signals

Printer status signals and the SW1 dipswitch positions are shown on 6030410 p 5. The first position on the dipswitch is used to select the digital board subassembly test program (when the board is on the digital board test station). SW1 position 2 is not used. SW1 position 3 is not used. The internal printer is an option, and dipswitch position 4 is opened when no internal printer is installed. This removes the choice of internal printer selection from several menus. Closing that switch restores the menu choices for the internal printer. These signals are read by the CPU as an I/O input strobing in the 8 bits from U21.

Beeper

The sound generator BP1 is driven by U24. Input to the driver are from the octal latch U33 which also contains some LCD display control signals.

Front Panel Keyboard (Output and Input Scanning)

The front panel keyboard connection (J6) is also shown on 6030410, page 5. The switches are connected through FB1 through FB10 ferrite beads to suppress any high-speed transients from getting back into the 601PRO. The switches are arranged in a 5 by 5 matrix, which is scanned by U21 ports A and B. Port A activates each line in turn, and port B inputs 5 lines for each Port A output, to determine which, if any, keys are pressed.

External Keyboard

The original keyboard interface (6040401), which provides the interface and functionality to the external keyboard of the 601Pro XL, has been replaced (the IC is no longer manufactured). A new design (2075838), based on the PIC 16C57C processor, has been released. The 601Pro XL firmware works the same independently of the hardware.

In order for the 601Pro XL to recognize the 2075838 design, SW1 position 3 must be set in the "OPEN" position.

The new keyboard interface (2075838) consists of a PIC 16C57C micro controller. Upon a key press of the external keyboard the PIC generates an interrupt signal. The 2075838 daughter board has hand shaking capability with the 80C188EB processor. A D flip flop and a nand gate accomplish this. The PIC, after transmitting a scan code will wait for the 80C188EB processor to change the state of the D flip flop via the RD and the PCKYBD chip select. The PIC cannot receive any data from the external keyboard until the main processor sets the D flip flop. The PIC software resets the D flip flop after each scan code is transmitted. If, for example, a multiscan coded transmission is initiated (like the INSERT key which has the following code serial transmission 0xE0 0x70 0xE0 0xF0 0xE0) then the external keyboard will hold each scan code in its output buffer until the PIC releases the CLOCK and DATA lines. The PIC will only release the CLOCK and DATA lines after the 80C188EB main processor answers the PIC's interrupt request.

6030410, sheet 2, shows the external keyboard interface where the keyboard plugs into the 5-pin DIN connector. The external keyboard interface is designed to function with IBM-compatible Personal Computer PC-AT style keyboards. When a key press is made, the keyboard chip U13, pin 35, issues an interrupt request to the microprocessor U1, pin 31. NOTE: In some units, the keyboard controller IC is replaced with a small PCB assembly containing the controller IC (U1) and an oscillator (U2). The microprocessor can then read and write to the keyboard chip, and input the key code of the key that is pressed. If a "wedge" style of barcode reader is connected to the keyboard interface, signals from the barcode reader will then be interpreted as if they were keyboard signals. Five-volt power for the keyboard and/or barcode wedge is limited by PTC2.

Functional Test Description

This section will describe the process of relay switching required to execute a particular test, as related from the 601PRO Series$_{XL}$ internal relays to the Test description by the selected test standard. The outlet control is used by almost all tests, and will be described generically first.

Outlet Control

General: The test standards require turning the outlet off and on and off, etc., and also opening L2, and earth, and reversing the L1 and L2 connections (which simulate possible failure conditions). The loads that must be switched can be a wide variety of loads, including purely resistive to motor loads. Particular care is taken when turning the 601PRO Series$_{XL}$ outlet off, to avoid generating excessive arcing and circuit transients. This makes the switching relays last longer, and increases reliability. The 601PRO Series$_{XL}$ uses a mix of solid-state and mechanical switching to perform a zero-crossing turnoff of the Device Under Test. Time delays built into the relay switching sequence reduce possible transients. A 25-millisecond delay follows every line in the relay sequences. The schematic of the power switching section is on 6030401, page 1.

Power Switching Components

Mains power comes in through the rear panel and is connected to the circuit breaker/switch on the front panel, then to J3 (6030401, page 1). Then the power circuit goes through the primary power switches K1 (IRY49) and K2 (IRY50), and then to K3 (IRY53)and K4 (IRY52) which provide open L2 capability (even when L2 has been switched to the other line),

then to K5 (IRY51)and K6 (also IRY51) which reverses L1 and L2, then K7 (IRY55) and K8 (also IRY55) which are provided to allow the DUT L1 and DUT L2 lines to be shorted (for VDE testing), then to the Device Under Test (DUT) receptacle. K53(IRY34) on Analog schematic p4 connects the 601PRO Series$_{XL}$ earth to DUT earth receptacle (which is also the 601PRO Series$_{XL}$ front panel green jack). The power to the DUT is always off at the main menu.

Relay Sequence Description

The 601PRO software defines a number of "Relay sequences" that control the outlet power and the input signal selection. Refer to the relay sequence section. The relay numbers following "ON" or "OFF" are switched as a group. A delay of 25 milliseconds is placed between each group unless an extra "WAIT " is also included.

Example 1: This sequence is used because the reverse polarity key was pressed at a time when the outlet already has L2 open, and the mains polarity is reversed. The action is to reverse the mains polarity, and still leave L2 open. (Since the mains polarity is reversed, "L2" is controlled by K4 instead of K3.)

Sequence: rev_outlet _on_L2_open_revpol

OFF, 52	Turn off IRY52 (K4) to keep L2 open
ON, 51,53,55	Turn on outlet IRY55 (K7+8) and IRY51 to reverse the polarity, and IRY53 to connect "L1"
Wait 50	Wait 50 milliseconds
ON, 49,50	Turn on Solid-State Relay (SSR) K1 and Mech Relay K2 (for no SSR heat sinking).

Example 2: Turning the outlet off:

Sequence: outlet_off

ON 49	Turn on the SSR. Be certain the SSR (K1) is connected in parallel with RY50 (K2)
OFF 50	Turn off Mech relay (K2)
OFF 49	Turn off the SSR (K1). Power is not actually removed until the current passes through zero.
Wait 150	Wait 150 milliseconds for the DUT to stop and dissipate power in R1
OFF 52,53,55	Open L1 and L2 to "initialized off state"
Wait 50	Wait 50 milliseconds

Example 3: Turning the outlet on (setting normal polarity and L2 on):

Sequence: outlet_on_normal

OFF 51	Polarity Relay to normal
ON 52,53,55	Connect the two "L2 control" relays and the DUT terminals (the unit is still unpowered)
Wait 50	Wait 50 milliseconds
ON 49, 50	Turn on both the SSR and the Mech relay

Software Note on Mains Power-Up Test

Upon power-up, and before the main menu is displayed, the 601PRO Series$_{XL}$ measures the voltage present between the three line voltage inputs. These voltages will be referred to as: L1_Earth, L2_Earth, and L1_L2.

The L1_L2 voltage is divided by the largest line voltage present when a leakage CAL was last performed to create a scale factor that is then applied to the Mains-on-applied-part offsets.

The L1_L2 voltage is then examined to determine which voltage range to use (115 or 230). This is necessary to set the Protective Earth Continuity power transformer primary configuration relay.

If the L1_L2 voltage is between 75V to 150V, the 115 range will be used.

If the L1_L2 voltage is less than 75V or between 170V to 270V, the 230 range will be used.

Next, the L1_L2 voltage is tested to see if the mains voltage is out of range: If L1_L2 is not within 80V to 145V or 170V to 270V, the Mains_Voltage_Out_Of_Range flag is set. The operator will NOT be notified at power-up if the mains voltage is reversed.

The three voltages are then examined to determine which line (L1 or L2) to open when an OPEN L2 fault is simulated, and to determine if an Open Earth condition exists. The reason for determining which line to open for an OPEN L2 fault is to keep the line with the highest potential relative to Earth connected, thereby permitting the highest leakage to Earth to occur in the normal polarity condition. The relays that open or close the L1 and L2 lines are ahead of the relays that reverse the polarity.

A description of the algorithm for determining which lead is called L2 and to check for an Open Earth condition, follows:

```
if in the 230V range
{
if ( L1_Earth >= 170.0 )  L2_STATUS = NORMAL;
else
      {
      if ( L2_Earth >= 170.0 )  L2_STATUS = SWITCHED;
      else
            {   /* both lines to earth are < 170 -- open earth or dual phase */
            if ( (L1_Earth + L2_Earth) > ( 0.95 * (L1_L2)))  L2_status = NORMAL;
            else
                  {
                  L2_STATUS = NORMAL;
                  OPEN_EARTH_ERROR = TRUE;
                  }
            }
      }
}
else in the 115V range
  {
  if ( (L1_Earth  >= 80.0 ) AND ( L2_Earth < 80.0 ))  L2_status = NORMAL;
  else
      {
      if (( L2_Earth  >= 80.0 )  AND  ( L1_Earth  <  80.0 ))  L2_STATUS =
SWITCHED;
      else
            {
            L2_status = NORMAL;
            if ( Mains Voltage is NOT Out Of Range )  OPEN_EARTH_ERROR =
TRUE;
            }
      }
  }
```

If it was determined that the L2_STATUS was SWITCHED, the 601 will open and close the 601 input L1 line instead of the L2 line when the test or operator requires that L2 be open or closed. NOTE: The “no earth” indication and actuation refers to the Earth connection to the front panel outlet (also known as functional earth and always connected to the green test jack). It is either connected to the 601 power input protective earth or not. It is never interchanged with some other signal.

At this point, the subroutine goes on to recover the leakage calibration offsets from the non-volatile memory and apply the line voltage scale factor to them, test the 500V DC source used for insulation resistance testing, test the memory backup battery voltage, and determine if the memory is full. Any errors except MAINS__VOLTAGE__REVERSED at power-up are displayed. The operator can choose to ignore them and continue by pressing the ESC button to get to the main menu.

Serial Port Hardware

IC U4 on page 1 of 6030410 generates the plus and minus voltages needed for the RS232 port, and buffers the RS232 inputs and outputs. The V+ (pin 11) and V- (pin 15) are normally 8 to 10 volts. The BCTX and BCRX signals shown on the schematic are not used (the P1 barcode port on page 2 is not populated with parts). The port signal names are relative to "Data Communication Equipment". Since this is "Data Terminal Equipment" the direction of the signal names is reversed; i.e., the RX signal is an output from the 601PRO, and the TX signal is an input.

The RTS (Request to send -- active low input) and CTS (Clear to send – active low output) – signals control the flow of data in and out of the port. If data is presented faster than the 601's microprocessor can accept it, the processor will set the CTS output high to signal the computer to stop sending data. Likewise, if the computer cannot accept data, it will signal the 601 pro to stop transmitting by setting the RTS input high.

Relay Identification and Switching

The Names are the software symbol names in positive logic. They refer to the relay control signal name IRY__ found on the schematics. The actual reference designation (K__) number is found on the schematic and Bill of Materials, and is printed on the circuit board. Tables 1 and 2 provide a cross reference of these signal names and the "K" relay number. In these tables, an apostrophe represents a negation (active low) of the signal.

Table 1. Analog Assembly Relay Names and Functions

Software & Signal Name	Relay RefDes	Function
IRY1	K39	Connects (LEAK-) to (V)
IRY2	K38	Connects (LEAK-) to (LL)
IRY3	K37	Connects (LEAK-) to (LA)
IRY4	K36	Connects (LEAK-) to (RL)
IRY5	K35	Connects (LEAK-) to (RA)
IRY6	K44	Connects (LEAK+) to (V)
IRY7	K43	Connects (LEAK+) to (LL)
IRY8	K42	Connects (LEAK+) to (LA)
IRY9	K41	Connects (LEAK+) to (RL)
IRY10	K40	Connects (LEAK+) to (RA)
IRY11	K19	Connects (LEAK+) to (DUTL1L2)
IRY12	K31	Connects (LEAK+) to (REDLD)
IRY13	K22	Connects (LEAK+) to (FE)
IRY14	K23	Selects (LEAK+) input
IRY15	K29	Connects (LEAK-) to (PE)
IRY16	K21	Connects (LEAK-) to (BLKLD)
IRY17	K32	PECCAL+ to VOLTS+
	K33	PECCAL- to VOLTS-
IRY18	K7	Reverses polarity of 100%
	K54	Reverses polarity of 100%
IRY19	K28	ECG terminals to LEAK-
IRY20	K30	Select LEAK- input
IRY21	K20	+ISOL to LEAK-

Table 1. Analog Assembly Relay Names and Functions (continued)

Software & Signa Name	Relay RefDes	Function
IRY22	K11	+ISOL or CAL to LEAK-)
IRY23	K5	(L1) to (LV+)
IRY24	K4	(PE) to (LV-)
IRY25	U2,Q3,Q4	on/off of 110%
IRY26	K6	(L2) to (LV-)
IRY27	K26	(REDLD) to (VOLTS+)
IRY28	K27	(BLKLD) to (VOLTS-)
IRY29	K15	Select VOLTS+ input
	K16	Select VOLTS- input
IRY30	K3	(PE) to (LV-)
IRY31	K17	(ISRC+) to (VOLT S+)
	K18	(ISRC-) to (VOLT S-)
IRY32	K2	1A / 25A
IRY33	K45	Connects ECG signals to (RA)
	K46	Connects ECG signals to (RL)
	K47	Connects ECG signals to (LA)
	K48	Connects ECG signals to (LL)
	K49	Connects ECG signals to (V)
IRY34	K53	PE to FE
IRY35	K24	PECST+ to VOLTS+
	K25	PECST- to VOLTS+
IRY36	K51,Q12	Enable PEC CAL
	K52,Q12	Enable PEC CAL
IRY37	K8	Enable leakage CAL signal
	K9	Enable leakage CAL signal
IRY38	U14,Q8	PEC Cur On/Off
IRY39	U1,Q1,Q2	500VDC On/Off
IRY40	K1	115/230 Primary to PEC Xmfr
IRY41	K34	FE to VOLTS -
IRY42	K12	-ISOL to REDLD
IRY43	K10	-ISOL to DUTL1L2
IRY44	K14	-ISOL to PE
IRY45	K13	-ISOL to FE
IRY46	K55	Leakage comp #2
IRY47	K56	Leakage comp #1

Table 2. Power Switching Assembly Relay Names and Functions

Software & Signa Name	Relay RefDes	Function
IRY49	K1	AC Power ON (SSR)
IRY50	K2	AC Power On (parallel w. SSR)
IRY51	K5,K6	Reverse outlet polarity
IRY52	K4	Outlet HOT (L1) line ON
IRY53	K3	Outlet NEU (L2) line ON
IRY55	K7,K8	DUTL1L2 to DUT L1 & DUT L2

Table 3. Digital Assembly J3 Signals (to Measurement Assembly J2)

Net Name	Digital J3	Dig I/O	Data Bit	Function
START	1	O	0	A/D serial start pulse
CLOCK	2	O	1	A/D serial data clock
AG3'	3	O	3	Voltage Gain ÷ 100
AG2'	4	O	2	A/D Gain ÷ 2
VOLTS'	5	O	4	Select volts / leakage
INSL'	6	O	5	Enable leakage load
AG1	7	O	6	PGA Gain select bit 1
AG0	8	O	7	PGA Gain select bit 0
IDATA	9	I	5	A/D serial data
IEC1010F	10	O	6	IEC1010 test load
+5DFM	11	O	--	Filtered digital power
+5DFM	12	O	--	Filtered digital power
AAMIF'	13	O	7	AAMI test load
RMS'	14	O	--	RMS (vs. DC Only)
DGND	15	O	--	digital power return
DGND	16	O	--	digital power return

Table 4. Digital Assembly J2 Signals (to Analog Assembly J1)

Signal Name	D-PCB J2 - pin	Direction	Function
RYDATA'	1	Output	Serial relay data
RYCLK'	2	Output	Serial relay clock – rising edge
RYSTB'	3	Output	Serial relay strobe – level sensitive
RYEN'	4	Output	Serial relay enable – level sensitive
+5DFA	5	Output	Filtered +5 power for optoisolators
+5DFA	6	Output	Filtered +5 power for optoisolators
	7		
	8		
DGND	9	Output	Filtered power return for optoisolators
DGND	10	Output	Filtered power return for optoisolators
	11		
	12		
	13		
	14		
DAC+	15	Output	Differential D/A output signal
DAC-	16	Output	Differential D/A output signal

Table 5. Digital Assembly J1 Signals (to Power Switching Assembly J5)

Name	Digital J1- pin	Direction	Function
RY42'	1	output	Active low relay control
PSGND	2	input	Digital power supply return
RY38'	3	output	Active low relay control
PSGND	4	input	Digital power supply return
RY37'	5	output	Active low relay control
PSGND	6	input	Digital power supply return
RY36'	7	output	Active low relay control
PSGND	8	input	Digital power supply return
RY35'	9	output	Active low relay control
PSGND	10	input	Digital power supply return
RY34'	11	output	Active low relay control
PSGND	12	input	Digital power supply return
+5PS	13	input	Digital power supply
+5PS	14	input	Digital power supply
+5PS	15	input	Digital power supply
+5PS	16	input	Digital power supply

Relay Startup Arrays

Description: This is source code that shows which relay signals are changed for a particular test. It contains startup arrays for relay initialization.

```
///*********************************************************************
//     601PRO XL RELAY SEQUENCES
///*********************************************************************

// outlet ON with normal polarity

outlet_on_normal =
          OFF  - 51
          ON   - 52,53,55
          WAIT - 50
          ON   - 49,50

// outlet ON with reverse polarity

outlet_on_revpol =
          ON   - 51,52,53,55
          WAIT - 50
          ON   - 49,50

dual_lead_leakage =
          ON   - 12,14,16

dual_lead_voltage =
          ON   - 27,28

pec_on =
          ON   - 36
          ON   - 38

ecg_on =
          ON   - 33

// open L2(neutral) when input mains is normal polarity

outlet_on_l2_open_normal =
          OFF  - 51,53
          ON   - 52,55
          WAIT - 50
          ON   - 49,50

// open L2(neutral) and reverse polarity when input mains
// is normal polarity

outlet_on_l2_open_revpol =
          OFF  - 53
          ON   - 51,52,55
          WAIT - 50
          ON   - 49,50

test1_l1_to_earth =
          OFF  - 26
```

```
        ON   - 23,24,29,31

test1_l2_to_earth =
        OFF  - 23,24
        ON   - 26,29,30,31

test1_l1_to_l2 =
        OFF  - 30
        ON   - 23,26,29,31

earth_cont_current =
        OFF  - 27,41
        ON   - 35

earth_cont_voltage =
        OFF  - 35
        ON   - 27,41

volt500_measurement =
        ON   - 13,21

l1_l2_insulation =
        ON   - 11,21

earth_leak =
        ON   - 13,15

enclosure_leak =
        ON   - 12,14,15

v_all =
        ON   - 1,7,8,9,10,14,19,20

ll_all =
        ON   - 2,6,8,9,10,14,19,20

la_all =
        ON   - 3,6,7,9,10,14,19,20

rl_all =
        ON   - 4,6,7,8,10,14,19,20

ra_all =
        ON   - 5,6,7,8,9,14,19,20

pec_trans_115 =
        ON   - 40

pec_trans_230 =
        OFF  - 40

outlet_off[6] =
        ON   - 49
        OFF  - 50
        OFF  - 49
        WAIT - 150
```

```
            OFF  - 52,53,55
            WAIT - 50

// sequence used to transition outlet power when configuring from
// on state to state
outlet_transition =
            ON   - 49
            OFF  - 50
            OFF  - 49
            WAIT - 200

signal_relays_off =
            OFF  - 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24
            OFF  - 25,26,27,28,29,30,31,32,33,35,36,37,38,39,41,42,43,44,45,46,47

pec_off =
            OFF  - 38

equipment_current =
            ON   - 29

v_lead_on =
            ON   - 6,14,19

ll_lead_on =
            ON   - 7,14,19

la_lead_on =
            ON   - 8,14,19

rl_lead_on =
            ON   - 9,14,19

ra_lead_on =
            ON   - 10,14,19

ap_all_on =
            ON   - 6,7,8,9,10,14,19,46

ecg_off =
            OFF  - 33

IsolatedMainsSupplyOff =
            OFF  - 25

IsolatedMainsSupplyOn =
            ON   - 25

main_ap_leak =
            ON   - 14,19,22,42,44,47

rev_pol_on =       // mains AP polarity
            ON   - 18

rev_pol_off =      // mains AP polarity
            OFF  - 18
```

```
// connects unit under test ground (FE) to protective earth
// conductor of 601pro

gnd_closed =
        OFF  - 34

// disconnects unit under test ground (FE) from protective earth
// conductor of 601pro

gnd_open =
        ON   - 34

ap_leads_gnd =
        ON   - 6,7,8,9,10

ap_leads_open =
        OFF  - 6,7,8,9,10

// L2(neutral) open when input mains is reverse polarity

rev_outlet_on_l2_open_normal =
        OFF  - 51,52
        ON   - 53,55
        WAIT - 50
        ON   - 49,50

// reverse polarity and L2(neutral) open when input
// mains is reverse polarity

rev_outlet_on_l2_open_revpol =
        OFF  - 52
        ON   - 51,53,55
        WAIT - 50
        ON   - 49,50

pec_selftest =
        ON   - 17,38

leak_self =
        ON   - 37

vde_patient =
        ON   - 6,7,8,9,10,14,19,22,42,43,45,46,47



vde_device =
        ON   - 6,7,8,9,10,11,12,19,22,42,45,47

volt500_off =
        OFF  - 39
        WAIT - 100

volt500_on =
        ON   - 39
        WAIT - 500
```

pec_25_amps =
ON - 32

pec_01_amps =
OFF - 32

single_lead_voltage = // Voltage RED to FE & PE = accessible voltage
ON - 27,41

ap_leads_open

pat_aux

outlet_disable_

Software Download

Software can be downloaded to the 601PRO by using the Biomed Download Utility (6040202-FW), which is a Windows 95 32-bit application. The purpose of this utility software is:

- Download a binary code file to the 601PRO Series$_{XL}$
- Download a language selection
- Download a serial number to assign the unit

After installing the utility:

- The user shall be able to select either COM1 or COM2 serial port. This selection shall be restored on subsequent loading of the program.
- The baud rate, parity, data and stop bits are fixed at 19200, n, 8, 1.
- The user shall be able to select the complete path and filename of the code file to download. This selection shall be restored on subsequent loading of the program.
- The user shall be able to select among the following languages for download: English, French, German and Italian. The default on loading of the program is English.

To initiate the download:

- Put the 601PRO in receive mode by powering it off and on. Within the first 3 seconds of power-up - while the unit displays "Initializing…." Press the key on the top panel labeled "Previous". At the PC, with the proper code selected as well as other options, select the Download button.
- At completion of the download a message will display on the PC and the 601 will reinitialize itself.

Chapter 3
Scheduled Maintenance

This chapter provides current maintenance requirements.

Scheduled Maintenance Requirements

The scheduled maintenance requirements are reflected in the following table.

Interval	Description
Annually	Calibration & recertification

Chapter 4
Performance Verification

This chapter provides performance verification information.

Service Calibration and Test Procedure

Equipment Required

(X) Requires listing on the Certificate of Calibration specified on the Data Sheet.

(**X**) 6030602 (Multi-Test Box)
(**X**) 5020105 or Equivalent (Current Test Station)
( ) 6032505 - Jig, Outlet Adapter, European
( ) 6032506 - Jig, Outlet Adapter United Kingdom
( ) 6032507 - Jig, Outlet Adapter, Australian
( ) Variac 100 - 250 VAC RMS, 5 amps, single phase, grounded
(**X**) DMM with Null Function HP Model 34401A or equivalent
(**X**) DMM with 10A Current Capability Fluke Model 45 or equivalent
(**X**) Calibrator, Fluke model 5100 B or equivalent.
( ) Parallel Printer with cable
( ) Windows 98 PC (or equivalent) with Hyper Terminal (or equivalent serial communications program).
( ) 6040201-SP (Contains specification-checksum and version number for firmware)
( ) Serial Cable (2238659) or equivalent
( ) Receptacle Tester, Ideal Industries, model 61-035 or equivalent
( ) 4 M Ohm +/- 1% resistor (No calibration necessary)
( ) 2245061 Keyboard (or IBM compatible keyboard with large 5 pin DIN connector)

MAKE NO ADJUSTMENTS OR MODIFICATIONS FOR "AS FOUND DATA"

Note: Tests may be selected through the Main Menu and "soft keys" or where applicable, with the front panel shortcut keys. To access the tests through the Main Menu, select TESTS/AUTOMODES, then select MANUAL, and use the "soft keys" until you come to the desired test. The "soft key" labeled MORE will toggle through all of the available tests. Select the test by pressing the associated "soft key". Whenever the "calibrator" is called for, another signal source monitored by the DMM may be used. If using the calibrator, the 50 ohm divider must be placed in the override mode for all tests. Some tests make measurements to the front receptacle bracket mounting screw. If the revision of the unit does not have such a part, the rear panel 601 Earth jack may be used instead.

1.0 SET-UP

1.1 Connect a parallel printer to the UUT.

1.2 Plug the UUT power cord into a Variac set to 115 VAC RMS ± 0.5 VAC and record on the data sheet.

Note: Use the HP 34401A DMM (or equiv.) for this measurement.

1.3 **Load Paper:** If Internal Printer option is installed, thread Printer paper into Internal Printer (See Final Assembly DWG for directions).

Note: The printer changed at rev D of this procedure. For rev D or later, Martel printers (black panel), there is no switch to program. For earlier Seiko printers (beige panel), the internal switch SW2 controls printing inversion. Check that it is in the left hand position for right side up characters.

2.0 POWER-UP

2.1 Turn the UUT power ON. Following startup screens with the firmware version, and a short delay; the UUT should display the MAIN MENU screen. Check Pass or Fail on Data Sheet.

3.0 UUT SYSTEM CONFIGURATION

Note: The nonvolatile parameters listed below are required to perform the test. If this is a new instrument these parameters will have automatically been set as part of the firmware download. If this instrument has been returned for service (with or without a new firmware download), go to the appropriate menu and change the settings to reflect the specified Default Parameters:

Default Parameters	**Access via:**
Class: I	Main Menu->CLASS/TYPE
Type: BF	Main Menu->CLASS/TYPE
Leads: 5 (all type BF)	View Present Settings Key on top panel
Test Standards Enabled: IEC 601-1, VDE 751.1, IEC 1010, AAMI	Main Menu->UTILITIES->ENABLE STANDARDS
Test Standard Selected: IEC 601-1	Main Menu->SYSTEM SETUP->TEST STANDARD
Select the printer type: Internal Printer if installed or select External Ascii Only if not installed	Main Menu->SYSTEM SETUP->PRINTER OUTPUT
Beeper Setting: On	Main Menu->SYSTEM SETUP->BEEPER

4.0 PRINTER TESTS

4.1 Internal Printer Test

If the unit has an internal printer, press the **print header** key and confirm that the internal printer starts printing. When it stops printing the printouts should look like the one shown below.

FLUKE BIOMEDICAL CORP.
Date Time
CONTROL#:_____
PROCEDURE ID#:_____
LOCATION:_____
DEVICE TYPE:_____
MANUFACTURER:_____
SERIAL #:_____
TECHNICIAN:_____
601PRO # nnnnnnnnn
STANDARD: xxxx
CLASS xx, TYPE xx
ECG LEADS: x
(Lead assignments noted)

4.2 External Printer Test

At the Main Menu select SYSTEM SETUP->Printer Output and select the appropriate External Printer. Return to the Main Menu and press the **print header** key and confirm that the external printer starts printing. When it stops printing the printout should look like the one shown below.

Note: The 601PRO # "nnnnnnnnn" should correspond to the serial number on the S/N label installed on the rear of the UUT. Record Pass or Fail on the data sheet.

FLUKE BIOMEDICAL CORP.
Date Time
CONTROL#:_____
PROCEDURE ID#:_____
LOCATION:_____
DEVICE TYPE:_____
MANUFACTURER:_____
SERIAL #:_____
TECHNICIAN:_____
601PRO # nnnnnnnnn
STANDARD: xxxx
CLASS xx, TYPE xx
ECG LEADS: x
(Lead assignments noted)

Note: The printer and printer cable are no longer needed and may be removed.

5.0 FINAL ASSEMBLY TESTS

Note: If using the calibrator, the 50 ohm divider must be placed in the override mode for all tests.

5.1 **System Check:** Verify all leads are detached from the instrument. From the UTILITIES menu select SYSTEM TEST. When test is complete the display should read **PASS**. Record Pass or Fail on the data sheet. Return to the Main Menu via the key labeled "Previous".

5.2 **Mains Voltage Test:** Select the **Mains Voltage** test and record reading, verifying data is within tolerance range indicated on the data sheet.

5.3 **Dual Lead Voltage Test:** Select the **Dual Lead Voltage** test by selecting the "soft key" from the Voltage Test. Apply the following voltages from the calibrator between the red and black jacks on the UUT. Record readings, verifying data is within tolerance range indicated on the data sheet

1.0VDC
1.0VAC @ 1KHz

5.4 **Dual Lead Leakage Test:** Access this test from the Main Menu->TESTS/AUTOMODES->MANUAL and press the "MORE" key to select the **Dual Lead Leakage** test. Apply the following voltages from the calibrator between the red and black jacks on the UUT. Record readings, verifying data is within tolerance range indicated on the data sheet.

500mVAC @ 1KHhz
1.0VDC

5.5 **Earth Leakage Test:** Select the **Earth Leakage** test. Apply the following voltage from the calibrator between the Green jack and rear panel 601 Earth jack. Record readings, verifying data is within tolerance range indicated on the data sheet.

1.0VDC

5.6 **Enclosure Leakage Test:** Select the **Enclosure Leakage** test. Apply the following voltage from the calibrator between the Red jack and rear panel 601 Earth jack. Record readings, verifying data is within tolerance range indicated on the data sheet.

1.0VDC

5.7 **Patient Auxiliary Current Test:**

Note: Enter number of Applied Part Leads by; “Main Menu” -> “View Present Settings” -> “Edit Leads” -> enter “5” via keypad then set up leads by pressing “Enter” six times.

Select the **Patient Auxiliary Current** test and each of the lead configurations shown below. Apply the following voltages from the calibrator between the **V2** jack on the UUT front panel and the selected jack. Record readings, verifying data is within tolerance range indicated on the data sheet.

Selected Jack	**Lead Configuration**	**Input Signal**
RA	RA-ALL	1.0VDC
RL	RL-ALL	1.0VDC
LA	LA-ALL	1.0VDC
LL	LL-ALL	1.0VDC
LL	V1-V6-ALL	1.0VDC

5.8 **Outlet Control Test:** Plug a **receptacle tester** into the unit's front receptacle (use an **outlet adapter if necessary)**. Select the **Mains Voltage** test then the Dual Lead "soft key". Use the DUT "soft key" to move between normal and reverse polarity and the **L2** and **EARTH** "soft keys" to verify that the polarity, L2 (Neutral line) and earth ground functions operate correctly (compare the display indications to the receptacle tester lights). The DUT "soft key" needs to be selected again to get back to normal polarity. Remove the receptacle tester. Check off Pass or Fail on the data sheet.

5.9 **Equipment Current Setup:** Press the ***esc*** key to return to the Main Menu (disconnects the outlet). Connect the **Current Calibration Station (Load)** to the test station outlet. Select one **5A load** on the current test station. Connect the DMM's 10A input to the Current Test Station's current output jacks, and setup the DMM using the Amp AC scale.

5.10 **Equipment Current Calibration & Test:**

5.10.1 Select the **Current Consumption** test. Record the readings on both the UUT and the DMM on the data sheet. Calculate the range and verify UUT reading is within tolerance (per calculation on data sheet. If the reading is not within spec, re-adjust RT1 on the Analog board. Lock the trimpot.

5.10.2 Press the DUT "soft key" to toggle between Normal and Reverse polarity along with the **L2** "soft key". Record readings, verifying data is within tolerance range indicated on the data sheet.

NORM POL, EARTH, NO L2
REV POL, EARTH, NO L2
REV POL, EARTH, L2

Press ***esc*** Key. Disconnect the Current Calibration Load.

5.11 Turn the UUT Power OFF.

Set the Variac voltage to **230.0 VAC RMS +/-0.5 VAC** and record on the data sheet.

Note: Use the HP 34401A DMM (or equiv.) for this measurement**.**

Turn the UUT Power ON.

5.12 **System Check:** Verify all leads are detached from the instrument. From the UTILITIES menu select SYSTEM TEST. When test is complete the display should read **PASS**. Check Pass or Fail on the data sheet.

5.12.1 Software Version Number: Record on the data sheet and verify software version number displayed corresponds to what is specified in the latest revision of 6040201-SP.

5.12.2 Software Checksum: Record on the data sheet, and verify checksum displayed corresponds to what is specified in the latest revision of 6040201-SP.

5.13 **Mains Voltage Test:** Select the **Mains Voltage** test. Record readings, verifying data is within tolerance range indicated on the data sheet.

5.14 **Insulation Resistance L1-L2 to Case Test:** Select the **Insulation Resistance** test (and select Mains L1, L2 - Case if necessary). Connect a power cord from the Multi-Test Box to the UUT front receptacle. Switch the L1/L2 switch on the Multi-Test Box **ON**. Connect a test lead between the Multi-Test Box jacks as indicated. Activate the Insulation Resistance test by pressing the **START TEST**

"soft key". Record readings, verifying data is within tolerance range indicated on the data sheet.

Connect test lead

L1/L2 to GND
L1/L2 to B1
L1/L2 to B2
L1/L2 to B3
No Lead

5.15 **Insulation Resistance ALL to Case Test:** Select the **Insulation Resistance ALL to Case** test by using the **AP INSUL** "soft key". Switch the **L1/L2 switch** on the Multi-Test Box **OFF**. Connect a test lead between the RA jack on the UUT front panel and the respective test jack on the Multi-Test Box. Activate the Insulation Resistance test by pressing the **START TEST** "soft key". Record readings, verifying data is within tolerance range indicated on the data sheet.

Connect test lead

RA to GND
No Lead

5.16 Detach all leads from UUT and remove power cord from the front receptacle.

5.17 At the Main Menu select SYSTEM SETUP->TEST STANDARD and then select the **VDE 751.1** test standard**.**

5.18 **Leakage Offset Calibration:** Select the VDE Equivalent Patient Leakage test. Press the **CALIBRATE** "soft key" then the CAL "soft key". Relays will click for several seconds while the display says "Calibration in Progress…". No Failure should occur. Check Pass or Fail on the data sheet.

5.19 **VDE Equivalent Patient Leakage Zero Test:** Press the **START TEST** "soft key" to activate the VDE Equivalent Patient Leakage test. Record readings, verifying data is within tolerance range indicated, on the data sheet.

5.20 **VDE Equivalent Device Leakage Zero Test:** Select the **Equivalent Device Leakage** test and press the **START TEST** "soft key" to activate the test. Record readings, verifying data is within tolerance range indicated, on the data sheet.

5.21 Use the DMM to measure the resistance of the 4MΩ resistor. Record reading, verifying data is within tolerance range indicated, on the data sheet.

5.22 **VDE Equivalent Device Leakage Test** Connect the 4MΩ test resistor between the **Outlet L1 or Outlet L2** and the **Green** Jack on the front panel. Press the **START TEST** "soft key" to activate the test. Record reading, verifying data is within tolerance range indicated, on the data sheet.

5.23 **VDE Equivalent Patient Leakage Test:** Select the **Equivalent Patient Leakage** test. Connect the 4MΩ test resistor between the **V1** Jack and the **Green** Jack on the front panel. Press the **START TEST** "soft key" to activate the test. Record reading, verifying data is within tolerance range indicated, on the data sheet.

5.24 At the Main Menu select SYSTEM SETUP->TEST STANDARD and then select **IEC 601-1** test standard.

5.25 **Mains on Applied Part – Leakage Test:** . Connect the 4MΩ test resistor between the **RL** Jack and the **Green** Jack on the front panel. Select the **Mains On Applied Part** test. The lead configuration should be ALL to EARTH. Press

the **START TEST** "soft key" to activate the test. Record readings, verifying data is within tolerance range indicated, on the data sheet.

5.26 **Mains on Applied Part – Zero Test:** Disconnect all leads from the front panel jacks. If necessary, select a lead configuration of ALL-EARTH . Press the **START TEST** "soft key" to activate the test. Record readings, verifying data is within tolerance range indicated, on the data sheet.

5.27 **Earth Resistance Calibration**

5.27.1 **1A Earth Resistance Calibration:** Select the **Earth Resistance** test. Connect the Red lead between the **Red jack** on the UUT and the **A1 jack** on the Multi-Test Box. Connect the black lead between the **Green jack** on UUT and the **A2 jack** on the Multi-Test Box. Press the **CAL** "soft key" and verify that the UUT returns from the lead calibration sequence with no errors. Check off Pass or Fail on the Data Sheet.

5.27.2 **10A Earth Resistance Calibration:**

Note: Check off “Not Applicable” on the data sheet if UUT does not have a 6040402 Analog +10 PCB and skip this step.

Select the **Earth Resistance** test. Connect the Red lead between the **Red jack** on the UUT and the **A1 jack** on the Multi-Test Box. Connect the black lead between the **Green jack** on UUT and the **A2 jack** on the Multi-Test Box. Press the **CAL** "soft key" and verify that the UUT returns from the lead calibration sequence with no errors. Check off Pass or Fail on the data sheet.

5.28 **Earth Resistance Calibration & Test**

5.28.1 **25A:** Select the **25 A** current level by pressing the **Amperes** "soft key". Press the **CAL** "soft key" and verify that the UUT returns from the lead calibration sequence with no errors. Record the readings, verifying data is within tolerance range indicated on the data sheet for the following resistance measurements on the Multi-Test Box by pressing the **START TEST** "soft key" to activate the test

Note: Cleanliness of the leads and jacks can affect the test.

Black & Red Lead Connections
A2 and A1
A2 and A4

5.28.2 **1A:**

Note: For the 1A and 10A Earth Resistance tests first check whether the UUT has a 6030529 Analog PCB or a 6040402 Analog +10 PCB. Perform the tests, filling in the appropriate lines on the data sheet, using the tolerance ranges for the installed PCB. Check as “Not Applicable” the lines on the data sheet for the PCB not installed.

Select the **1A** current level by pressing the **Amperes** "soft key". For the following resistance measurements on the Multi-Test box press the **START TEST** "soft key" to activate the test. Record the readings, verifying data is within the tolerance range indicated on the data sheet.

Black & Red Lead Connections
A2 and A4
A2 and A5

5.28.3 **10A:**

Note: Not Applicable unless 6040402 PCB Installed, mark N/A and skip.

Select the **10A** current level by pressing the **Amperes** "soft key". For the following resistance measurements on the Multi-Test box press the **START TEST** "soft key" to activate the test. Record the readings, verifying data is within the tolerance range indicated on the data sheet.

Black & Red Lead

Connections
A2 and A1

A2 and A4
Remove Test Leads

5.29 At the Main Menu select SYSTEM SETUP->TEST STANDARD and then select **AAMI** test standard.

5.30 Select the **Enclosure Leakage** test. Apply the following voltage from the calibrator between the Red Jack and rear panel 601 Earth jack, and verify that the measurements are correct. **(DS – Record Values)**

500mVAC @ 1KHhz
1.0VDC

5.31 At the Main Menu select SYSTEM SETUP->TEST STANDARD and then select **IEC 1010** test standard.

5.32 Select the **Accessible Voltage/Leakage** test and the Leakage "soft key". Apply the following currents from the calibrator between the Red Jack and rear panel 601 Earth jack, and verify that the measurements are correct. **(DS – Record Values)**

500µA @ 1KHhz
1000 µADC

5.34 At the Main Menu select SYSTEM SETUP->TEST STANDARD and then select **IEC 601-1** test standard.

5.35 If the language, when received, was something other than English: At the Main Menu select SYSTEM SETUP and use the MORE "soft key" to select LANGUAGE. At the prompt for selecting the keyboard language choose English followed by the Enter key. At the prompt for display/print language choose the "as received" language and press Enter. Return to the Main Menu and confirm a difference in the language.

5.36 Turn the UUT **Power OFF**. Remove power cord from back.

6.0 GROUNDING TEST

Set DMM to measure ohms. **Null the DMM test leads**. Measure the resistance from the ground pin of the power input connector (on the rear of the instrument) to the following locations:

1. Front receptacle bracket mounting screw . **(DS – Record Value)**
2. Top assembly side mounting screw. **(DS – Record Value)**

The resistance at these points should be **1.0 Ω MAXIMUM**.

7.0 COMPUTER CONTROL

7.1 Reconnect power cord to the back of the 601PRO, plug in and turn unit on. Connect a "straight through" serial cable between the computer's COM port and

the serial connection on the 601PRO. Check 601's setup menu to set COM parameters to 2400 N,8,1.

7.2 On the computer, open Hyper Terminal (or equivalent serial communications program). Check that the program is set for 2400 baud N,8,1 operation too. Send the commands one at a time, from the computer terminal program, to the 601PROXL and confirm the 601PROXL goes into computer control command on the display and that the results are received back on your terminal program:

Send text	**Text received back**
[SN]	XXXXXX
[CHK]	PASS, PASS
[CUR]	X.X
[Q]	No text received back, this command allows you to exit computer control.

Note: In place of the Xs above would be numbers sent from the unit.

Pass and fail criterion is not necessary, this test is to assure the unit's ability to function properly under computer control.

If no device under test is plugged in during the above current consumption test, 0.0 should be the text received back.

7.3 If the 601Pro operates properly under computer control and reports data back to the PC terminal program, check the proper spot on the data sheet.

END OF TEST PROCEDURE

601Pro XL Calibration Data Sheet

Use the following data sheet in conjunction with the calibration steps above.

Instructions

1. This data sheet is to be used with the referenced documents for service of the 601PRO Series XL.
2. The items in the section below labeled data are numbered to correspond with the referenced procedure.
3. Record the product serial number, date, and your signature in the space provided.
4. Record results in Table.
5. Requires use of "CERTIFICATE of CALIBRATION" Form SF8 Rev.___ as Page 1 & 2.

Serial Number	Technician	Certificate #	Date

UUT DATA		AS FOUND		CALIBRATION	
STEP	ITEM	RANGE/REQ.	DATA	RANGE/REQ.	DATA
1.2	Variac Setting	114.5 – 115.5 V	_____VAC	114.5 – 115.5 V	_____VAC
2.1	Unit Displays MAIN MENU at Power-Up	Pass	Pass____ Fail_____	Pass	Pass_____ Fail_____
4.1	Internal Printer	Pass (if internal printer)	Pass____ Fail ____ N/A_____	Pass Or N/A	Pass_____ Fail_____ N/A_____
4.2	External Printer	Pass	Pass____ Fail ____	Pass	Pass_____ Fail_____
5.1	System Check Checksum	Pass Record Only	Pass____ Fail ____ _____	Pass Per 6040202-MP	Pass_____ Fail_____ _____
5.2	Mains Voltage L1-Earth L2-Earth L1-L2	 112.3 – 117.8 0.0 – 2.0 112.3 – 117.8	 _____ _____ _____	 114.0-116.0 VAC 0.0-2.0 VAC 114.0-116.0 VAC	 _____ _____ _____
5.3	Dual-Lead V I 1.0 VDC 1.0 VAC 1 kHz	 0.98 – 1.02 Not Applicable	 _____	 0.99 - 1.01 VDC 0.96 - 0.99 VAC	 _____
5.4	Dual-Lead V II 0.5 VAC 1 kHz 1.0 VDC	 Not Applicable 989 – 1011 µA	 _____	 338 - 390 µA 993 - 1007 µA	 _____ _____
5.5	Earth Leakage	989 – 1011 µA	_____	993-1007 µA	_____
SteP	Item	Range/REq.	DATA	Range/Req.	Data
5.6	Enclosure Leak	989 – 1011 µA	_____	993-1007 µA	_____
5.7	Patient Aux. Current RA-ALL RL-ALL LA-ALL LL-ALL LL-VI-V6 ALL	 989 – 1011 µA 989 – 1011 µA 989 – 1011 µA 989 – 1011 µA 989 – 1011 µA	 _____ _____ _____ _____ _____	 993-1007 µA 993-1007 µA 993-1007 µA 993-1007 µA 993-1007 µA	 _____ _____ _____ _____ _____
5.8	Outlet Control	Pass	Pass_____ Fail _____	Pass	Pass_____ Fail _____

UUT DATA		AS FOUND		CALIBRATION	
STEP	ITEM	RANGE/REQ.	DATA	RANGE/REQ.	DATA
5.10.1	Load Current Calibration *DMM_____ A **DMM_____ A	(*Calculate +/- 0.3A of DMM) _____ to _____	(Record Only!) _____	(**Calculate +/- 0.1 Amp of DMM) _____to_____ __	(Adjust RT1) _____
5.10.2	Load Current Test No L2 Rev Pol. No L2 Rev Pol *DMM=_____ **DMM=_____	0.0 A 0.0 A (*Calc.: 5% +/- 2LSD of DMM) _____ to _____	_____ _____ _____	0.0 A 0.0 A (**Calc.: +/- 0.1 Amp of DMM) _____ to _____	_____ _____ _____
5.11	Variac Setting	229.5 – 230.5 V	_____VAC	229.5 – 230.5 V	_____VAC
5.12 5.12.1 5.12.2	System Check Firmware Checksum	Pass Record Only Record Only	Pass____ Fail_____ _____ _____	Pass Current per 6040202-MP	Pass____ Fail_____ _____ _____
5.13	Mains Voltage L1-Earth L2-Earth L1-L2	225.1 - 234.9VAC 0.0 - 2.0 VAC 225.1 – 234.9VAC	_____ _____ _____	228.0-232.0 VAC 0.0-2.0 VAC 228.0-232.0 VAC	_____ _____ _____
5.14	Ins. Res. L1-L2 to Case L1/L2 – Gnd L1/L2 – B1 L1/L2 – B2 L1/L2 – B3 No Lead	0.0 MΩ 0.7 – 1.3 MΩ 47.3 – 52.7 MΩ 237 – 263 MΩ “OVER”	_____ _____ _____ _____ _____	0.0 MΩ 0.8-1.2 MΩ 48.0-52.0 MΩ 238-262 MΩ “OVER”	_____ _____ _____ _____ _____
5.15	Insulation Res. All to Case RA –GND No Lead	0.0 MΩ “OVER”	_____ _____	0.0 MΩ “OVER”	_____ _____
5.18	Leakage Offset Calibration	No Failures Occur	Pass _____ Fail _____	No Failures Occur	Pass _____ Fail _____
5.19	Equiv. Patient Zero	0 – 6 μA	_____	0 – 1 μA	_____
5.20	Equiv. Device Zero	0 – 6 μA	_____	0 – 1 μA	_____
5.21	Test Resistance	Not Applicable	Not Applicable	3.96 to 4.04 MΩ	_____
SteP	Item	Range/REq.	DATA	Range/Req.	Data
5.22	Equiv. Device Lkg.	59 – 73 μA	_____	62 – 70 μA	_____
5.23	Equiv. Patient Lkg.	59 – 73 μA	_____	62 – 70 μA	_____
5.25	Mains on AP Lkg. ALL-EARTH	FWD: 59 – 73 μA REV: 59 – 73 μA	_____ _____	FWD: 62-70 μA REV: 62-70 μA	_____ _____
5.26	Main on AP Zero	All-E Fwd: 0–1 μA All-E Rev: 0–1 μA	_____ _____	All-E Fwd: 0–1 μA All-E Rev: 0–1 μA	_____ _____

UUT DATA		AS FOUND		CALIBRATION	
STEP	ITEM	RANGE/REQ.	DATA	RANGE/REQ.	DATA
5.27.1	1A Earth Resistance Cal.	Pass	Pass_____ Fail _____	Pass	Pass_____ Fail _____
5.27.2	10A Earth Resistance Cal. (6040402 PCB)	N/A (If 6030529 PCB) OR Pass	N/A?___ OR Pass_____ Fail _____	N/A (If 6030529 PCB) OR Pass	N/A?___ OR Pass_____ Fail _____
5.28.1	25A Earth Resistance: Cal Test A2-A1: Test A2-A4	No Errors 22.5 – 25.0 A 0.000-0.004 Ω 22.5 – 25.0 A 0.091-0.109 Ω	Pass____ Fail____ _____ _____ _____ _____	No Errors 23.00-25.00 A 0.000-0.002 Ω 23.00-25.00 A 0.095-0.105 Ω	Pass____ Fail____ _____ _____ _____ _____
5.28.2	1A Earth Res. (6030529 PCB) Test A2-A4: Test A2-A5 (6040402 PCB) Test A2-A4: Test A2-A5	Not Applicable __ Or 0.85 – 1.15A 0.090 – 0.110Ω 0.085 – 1.15A 0.946 – 1.054Ω Not Applicable __ Or 0.85 – 1.30A 0.090 – 0.110Ω 0.85 – 1.30A 0.946 – 1.054Ω	N/A ___ Or _____ _____ _____ _____ N/A ___ Or _____ _____ _____ _____	Not Applicable __ Or 0.85-1.15 A 0.095-0.105 Ω 0.85-1.15 A 0.962-1.038 Ω Not Applicable __ Or 0.90-1.25 A 0.095-0.105 Ω 0.90-1.25 A 0.968-1.038 Ω	N/A ___ Or _____ _____ _____ _____ N/A ___ Or _____ _____ _____ _____
5.28.3	10A Earth Res. (6040402 Only) Test A2-A1: Test A2-A4	Not Applicable __ Or 9.50 – 10.50A 0.000-0.004 Ω 9.50 – 10.50 0.091-0.109 Ω	N/A ___ Or _____ _____ _____ _____	Not Applicable __ Or 9.65 – 10.35 A 0.000-0.002 Ω 9.65 – 10.35 A 0.095-0.105 Ω	N/A ___ Or _____ _____ _____ _____
5.30	AAMI Enclosure. Lkg. 0.5VAC@1kHz 1.0 VDC:	338 – 390 µA 989 – 1011 µA	_____ _____	338-390 µA 993-1007 µA	_____ _____
5.32	IEC 1010 Access. Lkg. 500 µA@1kHz 1000 µADC	266-305 µA 978 – 1022 µA	_____ _____	266-305 µA 993-1007 µA	_____ _____
6.0	Grounding – Frt Grounding - Top	Not Applicable	Not Applicable	0.00-1.00 Ω 0.00-1.00 Ω	_____ _____
7.5	Op under PC Control	Sends and Receives Data	Pass_____ Fail _____	Sends and Receives Data	Pass_____ Fail _____

Chapter 5
Troubleshooting

This chapter provides troubleshooting tips.

Q: What should I do when the customer says "My unit no longer works and it smells like burnt components?"

A: If the user is using a Variac to adjust the Mains Voltage without powering off the unit, it is likely that they exceeded one of the operating ranges 120VAC (80VAC - 145VAC) or 240VAC (170VAC- 275VAC). Switching from 120VAC to 240VAC would be considered exceeding the operating range for 120VAC since 240 is greater than 145. This is described further in Functional Description, page 2-1.)

Q: If I want to switch from one foreign language to another, what do I need to do?

A: Use the SYSTEM SETUP menu and select LANGUAGES. Select the desired language for the User Interface. If you are also using a keyboard in that language, use the SYSTEM SETUP menu and select EXTERNAL KEYBOARD LANGUAGE. Select the desired language. The changes will be immediate. There is no need to cycle power on the unit.

Q: How do I download software to the 601PRO Series$_{XL}$?

A: **Refer to the instructions in Functional Description page 2-10.**

Q: How do I perform printer maintenance?

A: Perform the following steps:

1. Accessing the Internal Printer and Paper

The 601PRO has had more than one type of printer installed over its lifetime. Initially, the 601PRO was manufactured with a Seiko Thermal Printer installed. More recently however, a Martell Thermal printer has replaced the Seiko model to provide improved performance.

Before proceeding with the maintenance steps below, it's important to identify the type of printer installed in the 601PRO analyzer. The Martell printer is easily identified by its black colored chassis. The Seiko printer on the other hand, has a beige chassis. For the proper maintenance steps for the printer

installed, locate the section in the following text appropriate for the identified printer.

For the Martell Printer (black chassis)

A. Press the cover release and swing the printer cover away from the printer housing.

For the Seiko Printer (beige chassis)

A. Gently press the latch buttons on the sides of the front panel and remove the panel.

B. Using the red pull-tab on the printed circuit board (PCB), carefully pull the printer from its internal cradle, until you feel some resistance.

2. Replacing the Paper

For the Martell Printer (black chassis)

A. Remove the roll cap by squeezing the barbs at the end of the paper roll shaft.

B. Load a new roll (PN 2248743) oriented as shown in the figure above.

C. Feed a clean, straight edge from the roll into the entry port of the printer mechanism. The paper will be sensed automatically and feed into the front slot for printing.

D. Wind any excess paper onto the roll and replace the roll cap.

E. Close the printer cover.

For the Seiko Printer (beige chassis)

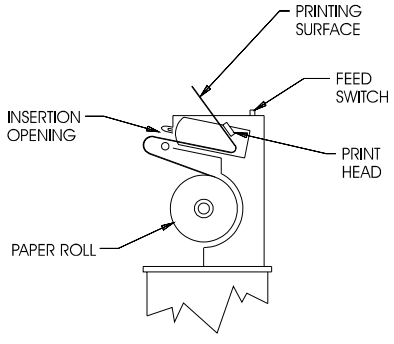


FIGURE 1

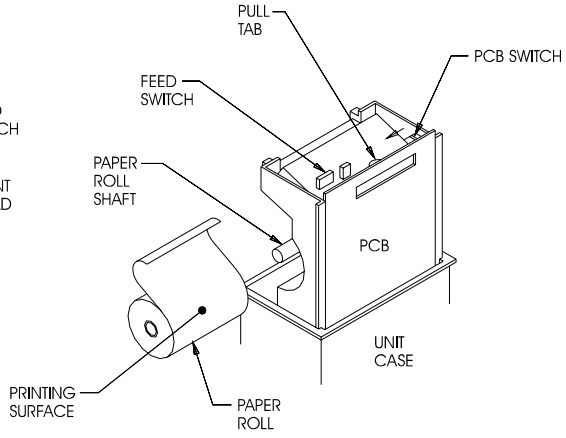


FIGURE 2

A. Slide the old roll of paper off its shaft.

B. Place the new paper roll on the shaft as illustrated in *Figure 2.*

Note: The outside surface of the paper roll is the printing surface.

3. Manually Advancing the Paper Feed
   A. Gently push the paper into the paper feed opening (*Figure 1*).
   B. Power up the unit.
   C. Press the feed switch until the paper emerges from the print head. If the rollers do not automatically move the paper forward, apply light pressure on the paper to manually feed it into the rollers.
4. Replacing the Printer in the Case
   A. Carefully place the printer back in the 601PRO case.
   B. Advance enough paper so that paper appears outside the output opening on the front panel.
   C. Make sure the printed circuit board switch is positioned toward the pull-tab (*Figure 2*).
5. Replacing the Protective Panel
   A. Replace the front panel of the unit, ensuring that the latches engage.
   B. Test the functionality by printing.
6. Cleaning the Printer
   A. Clean the top panel using a dampened cloth and mild detergent.
7. No cleaning of the internal components is required.

Chapter 6
Corrective Maintenance

This chapter discusses corrective maintenance.

There are no correction maintenance procedures beyond the calibration requirements.

Chapter 7
Installation

This chapter discusses installation requirements.

The Operating Environment

The *601PRO Series$_{XL}$* is designed to operate optimally when installed in an area where ambient temperatures remain between 10°C (50°F) and 40°C (104°F). The unit is sensitive to extreme environmental conditions. **Excessive humidity should be avoided. Condensation directly on the sensitive electronic circuits can cause the instrument to fail internal self checks.**

Unpacking and Repackaging the Instrument

If the shipping box has been damaged, inspect the instrument for visible dents and scratches as you unpack it.

If the unit is damaged, notify the carrier and your manufacturer's representative. Keep the shipping cartons and the packing material for the carrier's inspection. The manufacturer will arrange for the repair or replacement of your instrument immediately, before the shipping-related claim is settled.

If the unit is shipped to the factory for repair or replacement, it must be carefully repackaged. Shipping with improper packaging materials may void your warranty. An RMA must be obtained before returning any equipment for service. Contact Fluke Biomedical technical service for a return material authorization (RMA) number. This number should be marked on the outside of the shipping container.

Unpacking the 601PRO

1. Carefully open the top of the box, and remove any accessories. These will include a line power cord (US, UK, Australian or European), Operator's Manual, red and black test leads, warranty card, large red clamp, and five alligator clips.
2. Lift the 601PRO Series$_{XL}$ out of the box and remove the instrument from the plastic bag.
3. Pull the end caps off.

Repacking the 601PRO

1. Using a box large enough for adequate padding, package the 601PRO as best you can. Units arriving with damage due to inadequate packing may void the warranty and result in being billed for repairing the shipping damage.
2. Insure the package for the value of the unit.
3. Contact Fluke Biomedical (see contact info behind manual title page) for a Return Material Authorization (RMA) before shipping the 601PRO to Fluke Biomedical.

After Unpacking, Verify Performance

Prior to using the instrument for the first time, verify that the instrument is operating properly and that no damage occurred during shipping by running the Final Assembly Test Procedure (6040005-TP). See the *Service Calibration and Test Procedure* in Chapter 3.

Chapter 8
Parts List

This chapter contains a list of parts.

2250350 ISA601PROXL-UK

Item	Description	Qty
2234293	6041011,MEMBRANE KEYBOARD 601-03	1
2234378	6042014,PRINTER COVER PLATE 601-03	1
2234384	6042015,PRINTER BACK PLATE 601-03	1
152819	NUT,EXT LOCK,STL,6-32	4
2208869	42725,RECPT UK SNAP-IN 45MM	1
2231385	54014,SW RCKR 2-PLE 15A CKT BRKR	1
2233837	6031005,OVRLY POWER RATING	1
2234119	6040001,SHIPPING ACCESSORIES 601-88	1
2234162	6040500,TOP GENERIC ASBY 601-88	1
2234170	6040501,BASE GENERIC ASBY 601-88	1
2234210	6040506,HDW KIT GENERIC FINAL ASBY	1
2234231	6041003,DECLARATION OF CONFORMITY	1
2234246	6041004,OVRLY FRONT 601-88	1
2234268	6041006,OVRLY OUTLET 15 AMP	1
2238596	75024,PWRCORD SET UK W/IEC320	1

2250377 ISA601PROXL-US

Item	Description	Qty
2234293	6041011,MEMBRANE KEYBOARD 601-03	1
2234378	6042014,PRINTER COVER PLATE 601-03	1
2234384	6042015,PRINTER BACK PLATE 601-03	1
152819	NUT,EXT LOCK,STL,6-32	4
2208857	42724,RECPT US SNAP-IN 45MM	1
2231385	54014,SW RCKR 2-PLE 15A CKT BRKR	1
2233837	6031005,OVRLY POWER RATING	1
2234119	6040001,SHIPPING ACCESSORIES 601-88	1
2234162	6040500,TOP GENERIC ASBY 601-88	1
2234170	6040501,BASE GENERIC ASBY 601-88	1
2234210	6040506,HDW KIT GENERIC FINAL ASBY	1
2234231	6041003,DECLARATION OF CONFORMITY	1
2234246	6041004,OVRLY FRONT 601-88	1
2234268	6041006,OVRLY OUTLET 15 AMP	1
2238644	75033,POWERCORD US WITH C19 PLUG	1

2250298 ISA601PROXL-AUS

Item	Description	Qty
2004175	CLIP ALLIGATOR RED 4MM SOCKET	1
2212941	ADAPTER BANANA-ALIGATOR	5
2213241	PROBE/SAFETY TEST LEAD BLACK	1
2213252	PROBE/SAFETY TEST LEAD RED	1
2234104	PACKING SET SHIPPING	0
2234222	OPERATOR MANUAL 601-88 601PROS	1
2238659	CABLE RS232 9P M-F 6 FT	1
2241660	BAG JIFFY #2 8.5X12	0
2241901	SHIPPING DOCUMENT KIT	1
2248956	BAG POLY 26X32 2 MIL	0

2250338 ISA601PROXLG

Item	Description	Qty
2234302	6041012,MEMBRANE KEYBRD GERMAN 601-03	1
2234378	6042014,PRINTER COVER PLATE 601-03	1
2234384	6042015,PRINTER BACK PLATE 601-03	1
2233862	6031008,OVRLY POWER RATING GERMAN	1
152819	NUT,EXT LOCK,STL,6-32	4
2208878	42726,RECPT SCHUKO SNAP-IN 45MM	1
2231385	54014,SW RCKR 2-PLE 15A CKT BRKR	1
2234119	6040001,SHIPPING ACCESSORIES 601-88	1
2234162	6040500,TOP GENERIC ASBY 601-88	1
2234170	6040501,BASE GENERIC ASBY 601-88	1
2234210	6040506,HDW KIT GENERIC FINAL ASBY	1
2234231	6041003,DECLARATION OF CONFORMITY	1
2234268	6041006,OVRLY OUTLET 15 AMP	1
2234287	6041009,OVRLY FRONT GERMAN 601-88	1
2238615	75026,PWRCORDSET EUROPE W/IEC320	1

2250314 ISA601PROXL-SHK

Item	Description	Qty
2234293	6041011,MEMBRANE KEYBOARD 601-03	1
2234378	6042014,PRINTER COVER PLATE 601-03	1
2234384	6042015,PRINTER BACK PLATE 601-03	1
152819	NUT,EXT LOCK,STL,6-32	4
2208878	42726,RECPT SCHUKO SNAP-IN 45MM	1
2231385	54014,SW RCKR 2-PLE 15A CKT BRKR	1
2233837	6031005,OVRLY POWER RATING	1
2234119	6040001,SHIPPING ACCESSORIES 601-88	1
2234162	6040500,TOP GENERIC ASBY 601-88	1
2234170	6040501,BASE GENERIC ASBY 601-88	1
2234210	6040506,HDW KIT GENERIC FINAL ASBY	1
2234231	6041003,DECLARATION OF CONFORMITY	1
2234246	6041004,OVRLY FRONT 601-88	1
2234268	6041006,OVRLY OUTLET 15 AMP	1
2238615	75026,PWRCORDSET EUROPE W/IEC320	1

All units with printer include the following

Item	Description	Qty
2234391	6042016,THERMAL PRINTER KIT 601-03	1
2234181	6040502,CABLE PRINTER ASBY	1
2214711	4910-0013,SPACER #6 RD .125L BRASS	2
2184350	12017,SCR PNH M3X16 STL ZINC SLTD	2

2234162 Top Generic Asby, 6040500

Item	Description	Qty
178533	SCREW,PH,P,SEMS,STL,6-32,.250	9
2075814	**FBC601-PRO-4002, 6030410, DIGITAL PCA**	**1**
2233908	6031013,OVRLY REAR DIGITAL	1
2234090	6032018,PANEL I/O	1
2075838	**FBC601-PRO-4004, 6040403, KEYBOARD PCA**	**1**
2234196	6040503,DISPLAY 601-88	1
2234369	6042013,TOP COVER 601-03	1
2207698	42210,SCREWLOCK FM/25P SUB D	2
2217222	49950,GASKET EMI 0.4 X 0.08 PSA	2.895

2234170 Base Generic Asby, 6040501

Item	Description	Qty
1299692	SCREW,4-40,.375,PAN,PHILLIPS,STAINLESS STEEL,PASSIVATED	2
2184831	12144,SCR FLH 8-32X1/2 SS PHH	6
195255	NUT,EXT LOCK,STL,4-40	2
152819	NUT,EXT LOCK,STL,6-32	1
110817	WASHER,LOCK,INTRNL,STL,.267ID	1
2185890	18033,WSHR FNDR 6 SS	4
178533	SCREW,PH,P,SEMS,STL,6-32,.250	18
2186272	19348,SPCR MF 6-32X1.25 1/4 HEX AL	7
2013601	12-002-0002,CONN,4MM SFTY,BLK 23.3000-21	1
2207221	42019,SOCKET SAFETY LAB RED	1
172080	CABLE ACCESSORY ,CABLE ACCESS,TIE,4.00L,.10W,.75 DIA	2
2208092	42455,JACK BANANA NON-INSULATED	1
2208483	42583,SOCKET SAFETY LAB GRAY	10
2208490	42584,CONN PWR INLET C20 .25 TERM	1
2214172	4902-0087,HANDLE,PULL-OUT,CARRYING,MA	1
2209672	44265,PANEL MOUNTING FRAME	1
2213234	48381,JACK BANANA SAFTY .25 TAB GRN	1
2214567	49064,FOOT RUBBER 9/16 SQ BLACK	4
565036	CABLE TIE MOUNT ,CABLE TIE,MOUNT,ADHESIVE,0.19 WIDTH"	2
2216365	49354,WSHR,FINISH 4MM SS OR NICPL	4
2216886	49687,FOOT RUBBER WITH 8-32 STUD	4
2075823	**FBC601-PRO-4003, 6030401, AC POWER PCA**	**1**
2233590	6030506,CABLE XFMR CUR SOURCE ASBY	1
2233601	6030507,CABLE DC INTCON ASBY	1
2233612	6030508,CABLE AC PWR ANALOG PCB ASBY	1
2233620	6030510,CABLE AC PWR INPUT ASBY	1
2233647	6030512,CABLE ECG ASBY	1
2233658	6030513,CABLE LEAK/VOLTS SIGNAL ASBY	2
2233664	6030514,CABLE DC PWR INTCON ASBY	1
2233716	6030519,CABLE AC DISTRIBUTION ASBY	1
2233733	6030521,CABLE GROUND WIRE ASBY	1
2075845	**FBC601-PRO-4005, 6040400, MEASUREMENT PCA**	**1**
2075806	**FBC601-PRO-4001, 6040402, ANALOG PLUS 10 PCA**	**1**
2413050	6042019 ISA601PROXL BOTTOM ENCLOSURE 04	1
2134060	POWER SUPPLY,SW,85-264VAC,5V@4A,12V@2A,-12V@400MA,CHASSIS MOUNT,BULK	1
115477	WIRE,COPPER/TIN,BUS,24AWG	1
2202315	3111023,LABEL,GROUNDING SYMBOL	2