SmartArm™
NIBP Simulator

Service Manual

PN: 1501-00-11 REV 03

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Revision History

21-September-1996	Release at revision 01.
November - 2001	Release at revision 02.
18-June-2004	Release at revision 03.

Important Notice: While the warranty is in force, please do not open the unit without direct permission from the factory. Breaking the tamper seals, calibration and / or repair by unauthorized service providers will void the warranty. Please contact Clinical Dynamics for additional information.

Section 8. Routine Maintenance

INTRODUCTION

This section outlines the routine maintenance recommended for the **Smart**Arm.

Caution: The Smart Arm **contains static-sensitive electronic components. Observe ESD (electro-static discharge) precautions *at all times* when handling the instrument, and particularly when working inside the instrument.**

CLEANING

Caution: Do not immerse the Smart Arm **in liquid or use caustic or abrasive cleaners. Do not spray or pour liquid on the Smart**Arm **or its accessories. Do not sterilize the Smart**Arm**.**

To clean the **Smart**Arm, turn off its power and unplug the External AC Adapter from the AC mains. Dampen a cloth with a commercial, non-abrasive cleaner and wipe the exterior surfaces lightly.

BATTERY

A typical battery lifetime is approximately 500 charge/discharge cycles. By following these maintenance guidelines, battery life can be extended to 750 cycles or more.

Battery Care

1. To maximize battery life, do not connect the **Smart**Arm to the AC mains for more than 24 hours at a time. Ideally, the **Smart**Arm would be connected to the AC mains only when the battery was fully discharged and would be disconnected 16 hours later.

2. To maintain battery life, it is recommended that the battery be cycled (discharged and fully recharged) after every 30 hours of use. This will provide optimum battery performance throughout the life of the battery.

3. To cycle the battery:

    - Allow the battery to fully charge.

    - Disconnect the External AC Adapter from the **Smart**Arm.

    - Connect the **Smart**Arm to an NIBP monitor; set the **Smart**Arm to BP TEST mode and the NIBP monitor to automatic and 1 Minute interval.

    - Allow the **Smart**Arm to operate; a good battery will last approximately 150 simulations depending on battery condition. (Discharge may take up to 8 Hours if not running simulations.) A consistently short battery life indicates that the battery may need to be replaced or the charging circuit needs repair.

Battery Replacement

Caution: The battery pack is heavy and could potentially damage either the Smart Arm**'s components or nearby equipment; be prepared to support the battery pack whenever the nuts are removed.**

To remove the battery, first remove the Front Panel (see the subsection **Front Panel Disassembly** in Section 11). Disconnect the narrow ribbon cable from the push button switchboard. Disconnect the wide ribbon cable from the front of the CPU PCB, and place the top cover aside. Then turn the Bottom Assembly around and, using a 1/4-inch nut driver, remove the four lock nuts that secure the two battery brackets to the Battery Assembly bulkhead panel. Grasp the battery pack near its center and slide it forward in order to remove the battery bracket studs from their mounting holes in the bulkhead panel. Then rotate the battery pack and disconnect the battery cable from JP7 on the Power Converter PCB. Slide each battery bracket off the old battery pack and onto the new battery pack, being careful to align the brackets over the protective foam tape.

Caution: Even though the battery cable connector is polarized, extreme care should be taken when inserting the battery connector. Even a momentary polarity reversal could damage either the battery pack or the Power Converter PCB.

Reverse the above dismounting procedure in order to mount the new battery pack to the bulkhead panel. Ensure that the four battery bracket lock nuts are tightly "torqued down." (approximately 8 in/lbs.) Finally, replace the Front Panel; be careful not to kink any tubing. (See the subsection **Front Panel - Reassembly** in Section 11).

CALIBRATION

The **Smart**Arm's calibration should be checked annually. See section 9 Performance Verification. Please contact Clinical Dynamics for more information.

EXCHANGING the EPROM

Caution: A "PLCC Extractor Tool" must be used to remove the EPROM. The use of any other tool could damage either the EPROM or the socket.

The **Smart**Arm's firmware (software) resides in a 32 pin "PLCC" EPROM located in a socket on the CPU PCB. Use a PLCC extractor tool to remove the EPROM. Insert the extraction tool in the notches on the left front and right rear of the socket, then slowly squeeze the center of the extraction tool until the EPROM pops out. Do not over-squeeze the extraction tool!

To replace the EPROM, align the chamfered corner of the EPROM with the right front corner of the socket (also chamfered). Insert the right edge of the EPROM into the socket and then press down on the left edge of the EPROM until it snaps into place. Press down gently on the center and right of the EPROM to ensure that it is properly seated.

Section 9. Performance Verification

INTRODUCTION

Performance verification tests are completed with the **Smart**Arm fully assembled and allow an electronic technician to determine if the unit is functioning correctly.

Caution: The Smart Arm **contains static-sensitive electronic components. Observe ESD (electro-static discharge) precautions *at all times* when handling the instrument, and particularly when working inside the instrument.**

EQUIPMENT REQUIRED

- Calibrated Digital Manometer (Pressure reference reading mmHg)

NIBP SIMULATOR PERFORMANCE VERIFICATION

Powerup and Autozero Check

1. Turn on the **Smart**Arm and notice the initial offset reading. Ideally it will be 80 +/-10. The acceptable range is 10-110. Beyond this range, the unit will fail autozero.

2. Press any key to autozero, and again to proceed to the main menu.

Leak Check

1. Press F1 (LEAKTST) to enter the Leak Test Mode.

2. Press F3 (AUTO) which becomes F3 (MANUAL).

3. Connect the Inflation Bulb Adapter to the pressure port of the **Smart**Arm, and then connect the Leak Test Adapter (plugged at one end) to the Inflation Bulb Adapter.

4. Use the Inflation Bulb to inflate the system up to 200 mmHg +/- 20 mmHg.

5. Allow 10-20 seconds for the pressure to stabilize, then press the F4 (START) key to start the Test.

6. In Leak Test Mode, the top of the screen will display "Start P." (P=Pressure), "P. Drop", "Timer" and "Manometer". At the end of sixty seconds, the "Pressure Drop" and "Timer" will freeze and display the pressure drop as the leak rate in mmHg per minute. The Pressure Drop should be less than, or equal to, 3mmHg.

Static Calibration Check

SmartArm should read within 0.5mmHg across its entire range.

1. Press F1 (LEAKTST) to enter the Leak Test Mode.
2. Press F3 (AUTO) which becomes F3 (MANUAL).
3. Connect the Inflation Bulb Adapter to the pressure port of the **Smart**Arm, and then connect the Calibrated Digital Manometer pressure reference to the Inflation Bulb Adapter.
4. Use the Inflation Bulb to inflate the system up to 200 mmHg +/- 20 mmHg.
5. Allow 10-20 seconds for the pressure to stabilize, then compare the readings. **Smart**Arm should read within 0.5mmHg.
6. Deflate to 100 mmHg and note the reading.

Dynamic Simulation Check

Connect **Smart**Arm to a known good NIBP monitor using the appropriate adapter.

1. Press F3 (BPTEST) to enter the Blood Pressure Test Mode.
2. Start the NIBP Monitor to run a BP Test at the default 120/80 (95) 75 setting.
3. The results should be within the expected ranges (A typical results table is provided here).

SmartArm Simulation (Adult Mode)	***80 / 50 (60)***	***120 / 80 (95)***	***200 / 136 (166)***
NIBP Monitor	**Typical Results**	**Typical Results**	**Typical Results**
DINAMAP	**82 / 50 (60)**	**122 / 79 (95)**	**201 / 135 (166)**
GE Pro Series	**81 / 50 (60)**	**121 / 79 (94)**	**201 / 136 (166)**
H-P Merlin	**85 / 44 (58)**	**122 / 74 (91)**	**195 / 128 (153)**
Propaq Encore	**80 / 47 (60)**	**117 / 77 (92)**	**187 / 132 (155)**
Criticare 507	**84 / 48 (61)**	**124 / 78 (93)**	**198 / 132 (161)**
Philips M 3/4	**84 / 50 (59)**	**121 / 80 (93)**	**194 / 135 (162)**
Siemens	**85 / 49 (61)**	**122 / 78 (94)**	**198 / 135 (161)**
Datascope	**83 / 48 (61)**	**123 / 73 (92)**	**191 / 126 (158)**

The test results in the table above were obtained using **Smart**Arms to test blood pressure monitors using OEM adult cuffs and hoses. Typical test results will usually be within +/- 4 mmHg. Please note the following when using **Smart**Arm to test your blood pressure monitor:

Use only OEM **Smart**Arm Adapter Hoses. Use **Smart**Arm's Leak Test to test the monitor, cuffs, and hoses for leaks. Make sure the blood pressure monitor is in calibration (see blood pressure monitor service manual if you have any questions) before obtaining test results. The first result at each setting "seats the cuff", so please be sure to throw out the first result at each setting as the result may vary from additional test results at the same setting.

Battery Check

1. The unit will be left plugged in overnight to charge for 14-16 hours.

2. The following morning it should be unplugged and left ON (not simulating). A fast check at 2, 3 and 4 Hrs. to see if the unit is still on is all that is needed. If the unit is still on after 3 Hrs., then the battery is acceptable.

3. Units lasting less than 3 hours probably need a battery, but first verify the charge circuit is functioning properly. (See Section 12)

4. The unit should shutoff when the battery discharges to approx. 16v. If it is still trying to run with 15.8 volts or less, there may be a problem on the power board, which must be corrected.

Section 10. Troubleshooting

INTRODUCTION

This section is intended to supply possible remedies for problems that may occur. If the listed remedies do not solve the problem, contact Clinical Dynamics for further assistance.

Caution: The Smart Arm **contains static-sensitive electronic components. Observe ESD (electro-static discharge) precautions *at all times* when handling the instrument, and particularly when working inside the instrument.**

TROUBLESHOOTING GUIDE

No Power-Up On AC Power

1. If the front panel pilot light (the small green LED below the power switch) is illuminated, then the **Smart**Arm is powering up, however the display is blank. See **Blank Display** subsection below.

2. If the large green LED near the **Smart**Arm's POWER INPUT jack is *not* illuminated, then verify that the power plug from the External AC Adapter is fully seated into the jack. Then verify that the External AC Adapter is plugged into an operational AC outlet. If it is, then disconnect the External AC Adapter and test its output for approximately 24 VDC. If possible, test at full load conditions by connecting it to a 50 Ω, 20 Watt resistor. If the External AC Adapter is functional, then the problem is in the power input section of the CPU PCB. See the **CPU PCB Tests** subsection in Section 12 **Subsystem Tests** for more information.

3. If the large green LED near the **Smart**Arm's POWER INPUT jack *is* illuminated, then the most probable cause is a faulty Power Converter PCB or possibly a faulty Front Panel Keyboard. See the **Power Converter PCB Tests** subsection in Section 12 **Subsystem Tests** for more information.

No Power-Up On Battery Power

1. If the front panel pilot light (the small green LED below the red power switch) is illuminated, then the **Smart**Arm is powering up, however the display is blank. See **Blank Display** subsection below.

2. The battery may be discharged. Charge the battery for at least 1 hour before trying to power-up on battery power again. If after a full charge (12-14 hours) the **Smart**Arm still will not operate from battery power, see the **Power Converter PCB Tests** subsection in Section 12 **Subsystem Tests** for more information. If it is determined that the battery needs to be replaced, see the **Battery Assembly** subsection in Section 11 **Disassembly Guide** for more information.

Blank Display

1. Is the backlight on? If it is, after powering-up, the display will change from black to grey. If the backlight is *not* on, then the most likely fault is on the LCD Interface PCB. See the **LCD Interface PCB Tests** subsection in Section 12 **Subsystem Tests** for more information. If the backlight is on, continue with the remaining steps in this subsection.

2. Adjust the contrast control located just under the right edge of the Front Panel.

3. In order to complete Steps 4 and 5, refer to Section 11 **Disassembly Guide** to gain access to the interior of the **Smart**Arm.

4. Inspect the rear of the LCD Module (mounted on the back side of the Front Panel) for a bent frame or any other apparent damage.

5. Check the wide ribbon cable between the CPU PCB and the LCD Interface and the short, narrow ribbon cable between the LCD Interface and the LCD Module for crimped wires or any other apparent damage.

6. If none of the above solves the problem, the trouble is most likely on the CPU Board. See the **CPU PCB Tests** subsection in Section 12 **Subsystem Tests** for more information.

Self-Test Or Self-Calibration Failure During Power-Up Sequence

If zero-transducer fails, check to ensure that an external pressure is not applied.

For all other self-test failures, please contact Clinical Dynamics for assistance.

Dynamic Blood Pressure Simulator Not Functional

1. Check settings to ensure proper configuration achieved. Verify menu key displays " SIM: ON". See the Operation Manual, or contact Clinical Dynamics for more information.

2. Verify solenoids operate. There should be an audible tick when you enter BPTEST mode. While in this mode, use the inflation bulb adapter and a cuff, inflate by hand slightly, and relieve the pressure. There should be another audible solenoid tick as static pressure crosses approximately 15-20 mmHg

In order to complete Steps 3 and 4, refer to Section 11 **Disassembly Guide** to gain access to the inside of **Smart**Arm.

3. Check for kinked hoses and loose connectors.

4. Perform the **Supply and Reference Voltage Tests**, as described in Section 12 **Subsystem Tests**.

Leak Test Failure

1. Minimize the test setup and verify the leak is not external.

2. Verify solenoids operate. There should be an audible tick when you enter BPTEST mode. While in this mode, use the inflation bulb adapter and a cuff, inflate by hand slightly, and relieve the pressure. There should be another audible solenoid tick as static pressure crosses approximately 15-20 mmHg.

In order to complete Step 3, refer to Section 11 **Disassembly Guide** to gain access to the inside of **Smart**Arm.

3. Check for kinked or loose hoses and connectors. Also, verify the check valve is installed in line from the pump.

Section 11. Disassembly Guide

INTRODUCTION

This section provides information that will allow an experienced technician to disassemble the **Smart**Arm into its six major subassemblies:

1. Front Panel
2. Battery Assembly
3. Power Converter PCB
4. CPU PCB
5. Chassis
6. PPG Assembly

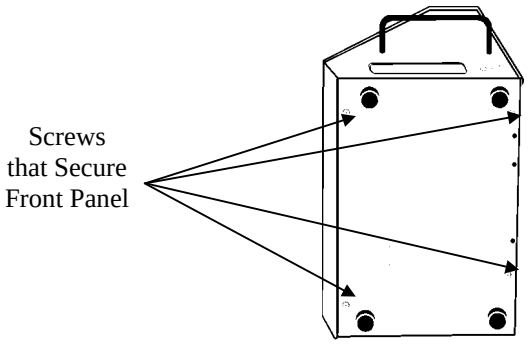
Caution: The Smart Arm **contains static-sensitive electronic components. Observe ESD (electro-static discharge) precautions *at all times* when handling the instrument, and particularly when working inside the instrument.**

DISASSEMBLY

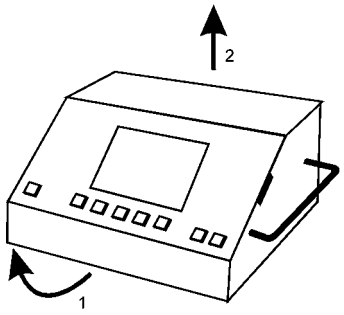
Front Panel – Disassembly

Caution: The Display backlight is a Cold Cathode Fluorescent (CCFL) type, using high voltage when on. Please be careful, as a battery powered device, the unit is easily turned on by accident when handling it.

1. Position the **Smart**Arm vertically on the left side rubber feet. Loosen the four screws on the Bottom Assembly. Remove these screws and set them aside. *Do not* loosen the three Torx screws along the rear edge.



2. Now position the **Smart**Arm in its normal (horizontal) orientation on the bottom rubber feet. Gently pull the front edge of the Front Panel upward and outward, as shown by Arrow 1 in the illustration below. After lifting the front edge slightly, pull back on the rear edge of the Front Panel and, while maintaining pressure against both the front and rear edges, lift the Front Panel straight up. The Front Panel ribbon cables have service loops that allow the panel to be set down just to the right of the Bottom Assembly. (The **Smart**Arm can be operated in this configuration, which is ideal for troubleshooting.)



3. Disconnect the narrow ribbon cable from the Switch Panel PCB. If additional work is to be done on the Front Panel, disconnect the wide ribbon cable from the LCD Interface PCB mounted on the inside of the Front Panel. If additional work is to be done on the Bottom Assembly, disconnect the wide ribbon cable from the CPU PCB.

4. The Switch Panel PCB can be removed by loosening the four Phillips-head screws securing it to the Front Panel.

Battery Bulkhead Assembly - Disassembly

Caution: The Battery Assembly is heavy and could potentially damage either the Smart Arm**'s components or nearby equipment; be prepared to support the Battery Assembly when the last screw is removed.**

Note: In order to remove the Battery Bulkhead Assembly, the Front Panel Assembly must first be removed.

1. Disconnect hoses at the quick connect fittings (2 places).

2. Position the Bottom Assembly vertically on the left side rubber feet. At the base of the Battery Assembly, loosen the three lock nuts, and then remove the three Torx screws (Phillips-head screws on early **Smart**Arm serial numbers) that secure the Battery Assembly to the Chassis. The preferred order for removing these screws is to work from bottom to top.

3. Slide the Battery Assembly out, taking care to unplug the battery cable - the red and black twisted pair extending from the left end of the battery pack to the *outermost* connector (JP7) at the rear of the Power Converter PCB.

4. Also, unplug the solenoids (JP5) and (JP4) as well as the pump (JP9).

Power Converter PCB - Disassembly

Note: In order to remove the Power Converter PCB, the Battery Bulkhead Assembly must first be removed.

The Power Converter PCB is connected to the CPU PCB by a 20-pin male "header" connector (JP1 on the Power Converter). A single screw secures the Power Converter PCB to the CPU PCB. An additional hold down stub may be present, mounted on the Battery Bulkhead but not affixed to the power converter PCB.

1. Position the Bottom Assembly in its normal (horizontal) orientation.

2. Unplug the battery *charging* cable from JP6 near the left rear corner of the Power Converter PCB.

3. Remove the Phillips-head screw near the right front corner of the Power Converter PCB that secures it to the CPU PCB. Now unplug the Power Converter PCB: The preferred technique for unplugging the Power Converter PCB is to grasp it with your left thumb on the inside corner of the board (near C1), your four left fingers under the rear edge of the board and your right thumb under the front edge of the board (near R6). Now pull up on all three edges, rocking the board slightly from left to right.

CPU PCB - Disassembly

Note: In order to remove the CPU PCB, the Battery Bulkhead Assembly and the Power Converter PCB must first be removed.

The CPU PCB is mounted to the Chassis by four Phillips-head screws.

1. Unplug the servo pot connector (JP22) and PPG coil connector (JP11). Gently pull the tubing off the pressure sensor (U27) at the left rear of the CPU board.

2. Remove the four Phillips-head mounting screws.

3. Slide the CPU PCB to the left, then rotate the right side of the board up to remove from the Chassis.

PPG Assembly – Removal

Caution: The PPG Assembly is precision aligned at the factory. Do not attempt to repair the assembly itself. The assembly should be treated as one individual part.

Note: In order to remove the PPG Assembly, the Battery Bulkhead Assembly and the Power Converter PCB must first be removed.

1. Unplug the servo pot connector (JP22) and PPG coil connector (JP11). Also disconnect the hoses at quick disconnect fitting.

2. Remove the rear handle bracket by prying off the black cover and removing 2 small nuts beneath.

3. Remove the PPG cover assembly (cuff cylinder) by removing 4 Torx head (T-10) screws.

4. Carefully hold the PPG Assembly and loosen the Hex head bolt that holds it.

REASSEMBLY

The reassembly instructions assume that the **Smart**Arm has been fully disassembled into its subassemblies: the Front Panel, the Battery Assembly, the Power Converter PCB, the CPU PCB and the Chassis. Please read this entire assembly procedure even if only a partial reassembly needs to be performed. This will ensure that all components and connectors are properly assembled.

CPU PCB - Reassembly

1. With the Chassis right side up, locate the coil and servo cables, tubing, and also the battery charging cable which is connected to the CPU board; these items must remain on top of the CPU PCB as it is placed into the Chassis. To place the board into the Chassis, angle the board underneath these items on the Chassis and then lay the board horizontal.

2. Connect the cables and hoses.

3. If necessary, connect the Switch Panel ribbon cable to JP2 (located in the right rear quadrant of the board). Ensure that the ribbon cable end with two "folds" is plugged into JP2 such that the cable is routed along the left side of JP2 and towards the front of the board.

4. On the right edge of the board, align the right angle LED and the "D" connectors with their respective panel cutouts and then slide the board to the right to seat the LED and "D" connectors into the panel cutouts.

5. Align the mounting holes near each corner of the board over the four threaded standoffs on the Chassis.

6. Install the 4 board mounting screws.

Power Converter PCB - Reassembly

The Power Converter PCB is connected to the CPU PCB by a single header connector. The pins of this connector ***must*** be properly aligned with the mating socket on the CPU PCB.

1. On the CPU PCB, move the battery charging cable (the red and black twisted pair attached to the DC power jack) to route under the power converter board and up the right of the Chassis so that it will not get caught against the battery bulkhead assembly.

2. Align the Power Converter PCB's header connector with the mating socket on the CPU PCB. Before seating the connector, view the CPU PCB socket from both the rear and the front to verify that none of the mating pins overlap the socket. Also verify that the mounting hole at the right front corner of the Power Converter PCB is aligned with the nylon standoff.

3. After fully seating the Power Converter PCB connector into the CPU PCB socket, install the short #4 Phillips-head screw through the mounting hole at the right front corner.

4. Route the battery *charging* cable (from the DC power jack) along the right panel of the Chassis and loop it around U1 (a vertically mounted 5 lead TO-220 package) on the Power Converter PCB board. Connect this cable to JP6 near the left rear corner of the Power Converter PCB.

5. To the right of JP6, verify that the jumper for JP8 is installed.

Battery Bulkhead Assembly - Reassembly

Caution: The Battery Assembly is heavy and could potentially damage either the Smart Arm**'s components or nearby equipment; support the Battery Assembly until it is secured by the mounting screws.**

1. Position the Bottom Assembly vertically on its left side rubber feet.

Caution: Even though the battery cable connector is polarized, extreme care should be taken when inserting the battery connector. Even a momentary polarity reversal could damage either the battery pack or the Power Converter PCB.

2. Connect the battery cable, the red and black cable extending *from the battery pack*, not from the CPU PCB, to JP7 on the Power Converter PCB. Be careful to observe the correct polarity when inserting this connector.

3. Also connect the solenoids (JP5) and (JP4) as well as the pump (JP9).

4. Move the Battery Assembly into position at the rear of the Chassis, carefully aligning Q1 (TO-220) with the socket on the CPU PCB. Hold it in position until the mounting screws have secured it.

5. From the exterior of the Chassis, install the three Torx screws (Phillips-head on early serial numbers) through the rear edge of the bottom panel, through the flange on the Battery Assembly bulkhead and into the lock nuts. The preferred order for installing these screws is to work from top to bottom. These screws should be firmly "torqued" down to approximately 8 in/lbs.

5. Verify that the Power Converter PCB does not touch the Battery Assembly.

6. Reconnect the hoses at the quick connect fittings (2 places).

Front Panel - Reassembly

1. Position the **Smart**Arm in its normal (horizontal) orientation on its bottom rubber feet.

2. Connect the narrow ribbon cable from the Bottom Assembly to the Switch Panel PCB and connect the wide ribbon cable from the LCD Interface PCB to the CPU PCB.

3. Position the Front Panel over the sloping section of the Bottom Assembly and route the ribbon cables towards the left side of the interior.

4. Gently pull the front edge of the Front Panel upward and outward and the rear edge backward. While maintaining pressure on both the front and rear edges, slide the Front Panel down over the Bottom Assembly. Be careful not to pinch either of the ribbon cables.

5. Position the **Smart**Arm vertically on its right side rubber feet. Install the four screws through the Bottom Assembly into the tapped brackets on the Front Panel.

Section 12. Subsystem Tests

INTRODUCTION

Subsystem tests require varying levels of **Smart**Arm disassembly and allow an *experienced* electronic technician to determine if individual subsystems (e.g., circuit boards) are functioning correctly. These tests do not need to be performed as regular maintenance. This information is included for troubleshooting and should only be performed if the **Smart**Arm fails any of the Performance Verification tests. If any of the subsystems do not pass the tests described below, contact the Clinical Dynamics Service Department for repair/replacement assistance.

Caution: The Smart Arm **contains static-sensitive electronic components. Observe ESD (electro-static discharge) precautions *at all times* when handling the instrument, and particularly when working inside the instrument.**

POWER CONVERTER PCB

This test is performed with only the Battery Assembly and Front Panel removed. Place the Battery Assembly such that it will not interfere with measurements on the Power Converter PCB, *but is still connected to JP7*. Do not disconnect the ribbon cables from the Switch Panel and LCD display.

Note: Unless otherwise specified, use the tab of U1 as the ground reference for Power Converter PCB measurements. (U1 is a 5 pin TO-220 package mounted on the right edge of the board.)

Equipment Required

- Adjustable DC Power Supply, 0-25 VDC, 0.5A Continuous, 3A Surge
- Digital Multimeter (DC Volts, DC mAmps), 0.5% accuracy or better
- Storage Oscilloscope, 1 MHz bandwidth minimum
- Micro Clip Lead

Supply and Reference Voltage Tests

1. With the **Smart**Arm off, but the battery connected to the Power Converter PCB, monitor +5VSTBY at U8 pin 14. Verify +5VSTBY measures between +4.75 - +5.25 VDC.

2. Connect the External AC Adapter to the POWER INPUT connector.

3. Power-up the **Smart**Arm by pressing the red POWER key on the Front Panel. Measure the following voltages:

Test Point	Label	Value
U8 pin 14	+5VSTBY	4.75 V to 5.25 V
JP1 pin 9	+Vs	14.25 V to 15.75 V
JP1 pin 11(13)	Vcc	4.75 V to 5.25 V
JP1 pin 5	-VLCD	-22.0 V to -24.0 V
	(-VLCD -17V to -19V for non-backlight display)	

Supply Current Tests

1. Power-down the **Smart**Arm and disconnect the External AC Adapter.

2. Disconnect the battery from JP7.

3. Set the adjustable DC power supply to 19 VDC, then power-down the supply. Connect the supply to JP7 as follows: positive to the pin near the board's edge, negative to the pin near JP6.

4. Remove the jumper from JP8. Configure the digital multimeter (DMM) to measure as an ammeter. Connect the ammeter leads as follows: positive to JP8 lead closest to notch, negative to lead closest to Q8.

5. Turn on the DC power supply.

6. Power-up the **Smart**Arm and verify the current does not exceed 350 mA.

7. Power-down the **Smart**Arm and verify the current does not exceed 700 uA.

8. Turn off the DC power supply and disconnect it from JP7, remove the ammeter from JP8, and reconfigure the DMM to measure voltage. Replace the jumper on JP8.

Battery and Battery Charger Tests

1. Disconnect the battery from JP7.

2. Verify that the battery open terminal voltage is between 16V-22V.

3. Reconnect the battery to JP7. Connect the External AC Adapter to the POWER INPUT connector.

4. To test the battery charger, connect the DMM to measure the voltage across R22. Clip the positive lead on the left side of R22 (closest to the edge of the board) and the negative lead on the right side of R22 (closest to F1). Verify the voltage measures 70-80 mV.

Caution: In Step 5, do not short the two JP7 pins without first disconnecting the battery from JP7.

5. Disconnect the battery from JP7. *Simulate* a shorted battery by attaching the micro clip lead across JP7 as follows: attach one clip to the pin near the board's edge, the other clip to the pin near JP6.

6. Verify the voltage across R22 measures between 9-13 mV.

Reset Generator Tests

1. Using the oscilloscope, monitor RSTDRV at U7 pin 9 (U7 is an ICM7556). When the **Smart**Arm is first powered up, verify a single pulse at least 40 msec wide. This measurement may require cycling the power on/off a few times to properly trigger on the rising edge of the pulse.

CPU PCB

See "Disassembly" instructions first. These tests are performed with the Analog PCB removed, but with the Power Converter PCB and Front Panel connected. All tests are performed in a default power-up state unless stated otherwise.

Note: Use JP15 pin 64 as the ground reference for CPU PCB measurements. (JP15 is the long male header connector on the front edge of the board. Pin 64 is the leftmost pin on the front row.)

Equipment Required

- The **Smart**Arm's External AC Adapter, or a 24V, 400 mA Power Supply
- Digital Voltmeter, 0.5% Accuracy
- 100 MHz Oscilloscope
- Micro Clip Lead

Equipment Setup

1. Disconnect the display (wide) ribbon cable from the CPU board.

2. On the CPU PCB, set RSTDRV high by using the clip lead to jumper TP2 (located near the left front corner) to Vcc (located at JP15 pin 6 - pin 6 is on the front row of JP15, third pin from right).

3. Plug the External AC Adapter into a known good AC outlet.

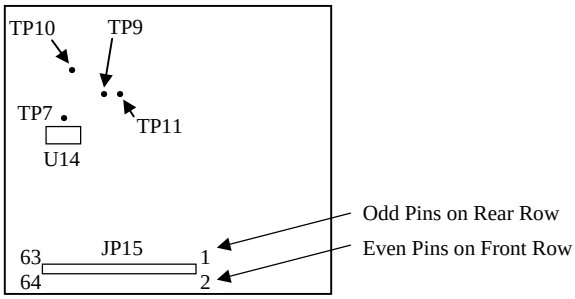
Supply and Reference Voltage Tests

1. Plug the External AC Adapter into JP18, the Power Input jack of the **Smart**Arm, and verify that the green LED next to the jack illuminates.

2. Power-up the **Smart**Arm; there will be NO DISPLAY since the LCD ribbon cable is not connected, and the microprocessor is held in reset.

3. Using the board diagram shown below to locate the test points, verify the following voltages:

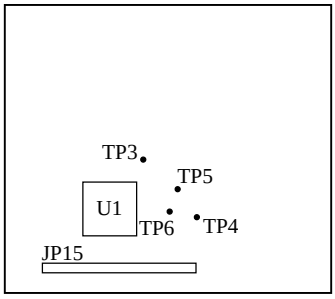
Test Point	Label	Value
JP15 Pin 6	Vcc	4.75 V to 5.25 V
TP7	+2.5VREF	2.37 V to 2.63 V
TP9	+5VREF	4.75 V to 5.25 V
TP10	+1.25VREF	1.18 V to 1.31 V
TP11	-5VREF	-4.75 V to -5.25 V
JP15 Pin 18	+Vs	14.25 V to 15.75 V
JP15 Pin 14	-Vs	-14.25 V to -15.75 V
JP15 Pin 12	+5VANA	4.75 V to 5.25 V



Clock Oscillator Tests

1. Using the oscilloscope, check the following clock signals, verifying good waveshapes and correct frequencies. Use the board diagram below to locate the test points.

Test Point	Label	Frequency	Period
TP3	CPUCLK	7.159 MHz	139.7 nS
TP4	14MCLK	14.31818 MHz	69.84 nS
TP5	BAUDCLK	1.843 MHz	542.5 nS
TP6	32KCLK	20 to 40 KHz	25 to 50 uS



Microprocessor and LCD Controller Tests

1. Power-down.
2. Remove the RSTDRV jumper from TP2.
3. Power-up and verify Vcc is still 4.75 V to 5.25 V.
4. Verify the microprocessor is operating by monitoring TP8. There should be pulses every 5 msec with an amplitude of approximately 0 to +10V.
5. Power-down and connect the LCD display ribbon cable to JP1.
6. Power-up and verify that the LCD display is active. On the display, verify that the self-test passed.

Section 13. Theory of Operation

The **Smart**Arm has five printed circuit boards:

- Power Converter PCB
- CPU PCB
- LCD Interface PCB
- Switch Panel PCB
- Analog PCB

The following sections describe the circuit functions on these boards.

POWER CONVERTER PCB

The Power Converter PCB contains the power on/off circuit, the two switch-mode voltage regulators, the +Vs (15V) linear voltage regulator, the battery charger and the low battery shutdown circuit.

Power On/Off

U7A (one-half of a CMOS 556 timer) and U8B (one-half of an 'HC74 D flip-flop) control the power-on state of the instrument. These components are powered by the +5VSTBY supply from U6, a low power 5V regulator. U6 is always energized, even if the instrument is off, allowing U7 and U8 to remain active and respond to the logic-level power-on signal from the front panel power switch.

Pressing the front panel power switch (a momentary SPST) grounds PWROn*, and the resulting falling edge is AC-coupled to the trigger input of the 556 timer (U7A). The timer generates a single active high pulse, which drives the clock input of U8B. Since U8B is configured as a toggle flip-flop with a positive edge clock, the flip-flop's state is toggled on the leading edge of the timer's output pulse. The timer's output pulse width is chosen to be sufficiently long to "debounce" the front panel switch, eliminating the multiple flip-flop toggles that would occur if the front panel power switch were connected directly to the flip-flop's input. Assuming the instrument was powered-down, the flip-flop will then toggle its SHUTDOWN* output from low to high. When SHUTDOWN* goes high, it turns on Q10, a P-channel power MOSFET, which in turn connects the +VPPG supply voltage to the three primary voltage regulators (U1, U3 and U5), powering up the instrument.

The SHUTDOWN signal (the flip-flop's complementary output) is AC-coupled to the trigger input of U7B (the other half of the 556 timer) in order to generate a reset pulse during the power-up sequence. This reset pulse (RSTDRV) goes active on the falling edge of SHUTDOWN (the rising edge of SHUTDOWN*) and has a duration of at least 40 msec. Since the Vcc voltage and the clock oscillator used by the CPU PCB both stabilize within 10 msec after the falling edge of SHUTDOWN, the RSTDRV pulse guarantees not only that the CPU circuits will be held inactive as Vcc ramps up from 0 to 5V; but that they will also "see" a sufficiently long reset pulse after they are powered-up and their clocks are active.

Battery Charger

Battery charging is controlled by U1A when AC power is made available. When the external AC adapter is connected, +VPPG will be at +24 VDC; this will power U1A, which is set up as a comparator. When the output of U1A is negative, Q8 will conduct and allow +VPPG to charge the battery through diode D8.

Resistors R16 and R17 set a voltage divider at the negative input of U1A. Another voltage divider, SWITCHED GND, is set up at the junction of the battery's negative terminal and R22; this is fed to the positive terminal of U1A. When the battery is being charged, current will flow through the battery then through R22 to ground. The value of R22 is set up so that when the battery charge current limit is reached the induced voltage on R22 will cause U1A to turn transistor Q8 off (output of U1A positive=Q8 off).

NOTE: Resistor R22 is in circuit only when the external AC adapter is plugged into the analyzer (JP10). When the plug is removed, R22 is shorted to ground, or the negative terminal of the battery is grounded.

Low Battery Shutdown

See "Battery Module" schematic. Comparator U9B is used to monitor the +VPPG line when operating off of battery power.

Should the +VPPG line ever fall below 16 volts, the voltage divider at the junction of R20 and R21 will turn the output of U1B high, turning Q9 on. This will bring the ENABLE PWR line low. The reset input on U8B will reset, and the SHUTDOWN line will turn the monitor off. This prevents any damage from low supply voltages. As long as the +VPPG line is above 16 volts, then the output of U1B will remain low, keeping Q9 off.

CPU PCB

The CPU board contains the processor and all its support circuitry, additional voltage regulators (aside from the ones on the power module), interface circuitry, multiplexing and an A/D converter.

AC Power

See "PSUPPLY" schematic. The external AC adapter supplies 24 VDC at 0.5A for operating the analyzer and charging the battery. The 24VDC from the adapter enters the analyzer at JP10. The POWER INPUT indicator, LED D1, (located near the power input jack) will illuminate green when this voltage is present. Resistor R130 is a current limit for the LED. Diode D2 prevents the +VPPG from backfeeding through to JP10 when operating on battery power. When the 24VDC is present, D2 is forward biased and allows the adapter to power the analyzer and charge the battery. Therefore when the analyzer is running off the external AC adapter, the battery is being charged, even if the analyzer is not turned on.

Voltage Regulators and Reference Generator

See "PSUPPLY" schematic. Other necessary voltages are generated when U5 (+15VDC) and U3 (-VLCD) are activated by turning the analyzer on. A positive 5 volt reference (+5VREF-TP9) is generated from the +2.5 VREF from U14 (A/D converter) by U46D, a positive amplifier with a gain of 2. This 5 volt reference is then fed to U46A, which is set up as an inverting amplifier with a gain of 1, providing a negative 5 volt reference (-5VREF-TP11). The +15 VDC, also labeled as Vs, feeds U32, a +5VDC regulator. The -VLCD, also labeled -23VLCD feeds U34, a negative 15 volt regulator labeled as -Vs.

Clock Signals

There are three different clocks generated by the system. Crystal Y1 (14.31818 MHz) provides the timebase for the CPUCLK used by the microprocessor subsystem. Depending on the setting for jumper JP3, the CPUCLK is obtained directly from the output of the Y1 oscillator, or is obtained from the divide-by-2 flip flop U12A. The standard setting for JP3 selects the divide-by-2 path and sets the CPUCLK equal to 7.159 MHz. The BAUDCLK signal is used by the UART for generating the serial communication baud rates. This clock is generated by Y2 and its associated circuitry. The 32KCLK clock is derived from an RC oscillator and used to drive the power-up state machine of the microprocessor subsystem. Since this clock is not used for precise timing, its exact frequency is non-critical and can be anywhere from 20 to 40 kHz.

CPU

The analyzer is controlled by processor U1. It uses a 20 bit address bus labeled ADR0-ADR19 and a sixteen bit data bus labeled RD0-RD15 with 256K of RAM (U2). The system software is stored in U26, and RAM refresh is handled by U3 (lower data byte) and U4 (upper data byte).

Multiplexing

Several analog signals are monitored by the analyzer and converted to digital information for analysis. The multiplexing of the signals is handled by U17. The MUXA-MUXC lines control which one of eight signals is switched to U17's output pin 3. The selected output is buffered by U46C before being read by the A/D converter U14. Both +5V and -5V supplies are required by U17 for operation. The following signals are analyzed by the system:

+VPPG-the battery voltage divided down by R63 and R64 in order to obtain a level acceptable for U17. This line is monitored while operating on battery power to determine battery life.
ArmMuxOut multiplexed signal from the SmartArm board

A/D Converter

The 12 bit A/D converter U14 receives its input signal buffered from multiplexor by U46C. When the OE1* line from the processor (pin87) is inverted by U15A pin2 as the CONVERT* line is brought low, a conversion will occur; and the results will be output on the RD0-RD11 lines. When the CONVERT* line is high, then a read will occur. The recently converted data will then be read by the processor. The input voltage range can be from 0-10 volts. The +2.5VREF is generated by U14 and is used for generating other reference voltages for the system.

Interfaces

Both a serial and parallel interface are available on the **Smart**Arm analyzer. Both the DB25 (parallel) and the DB9 (serial) connectors are controlled by UART U7. The output from U7 is connected directly to the DB25 connector while the serial output lines for the DB9 are converted to RS232 levels by U23.
This chip also converts the serial input lines from RS232 levels to logic levels for U7. Capacitors C19 and C20 are required by U23 to develop the necessary RS232 voltage levels from Vcc.

The following table lists the various signals and their descriptions:

Signal	Description
STB	standby
ERR	error
INIT	initialize
SLIN	printer select output
ACK	acknowledge
BUSY	busy
PE	peripheral enable
SLCT	printer select input
PD0-PD7	parallel data lines
TX1	serial transmit data
DTR	serial Data Transmit Ready
RX1	serial receive data
DSR	serial Data Set Ready

LCD INTERFACE PCB

Contrast Control

The LCD display is a 320 X 240 0.30mm pitch backlit display. The contrast control for the display is contained on a daughter board and consists of potentiometer R5, and resistors R4 and R6. The resistor divider enables a more linear control over the contrast of the display. Power for the display is developed by power inverter M1. This is turned on by the DISPON* (active low) line from the processor. When DISPON is high, Q3 will conduct and activate M1 by completing the VIN- path to ground.

Section 14. Parts List

Please have the unit S/N available when ordering replacement parts. We maintain a full history of each unit on file, which helps us to ensure the proper parts are sent to match the actual hardware and firmware revisions of your unit.

SmartArm Simulator (P/N 9000-00-01)

Ref. Des.	Part No.	Description	Qty.
	2003-00-01	SMARTARM FRONT PANEL ASSEMBLY	1.0
	2004-00-01	SMARTARM BOTTOM ASSEMBLY	1.0
	3100-00-01	SMARTARM ACCESORY KIT	1.0
	87004	24VDC POWER SUPPLY 100 -140VAC	1.0
	87005	DETACHABLE LINE CORD	1.0

SmartArm Front Panel Assembly (P/N 2003-00-01)

Ref. Des.	Part No.	Description	Qty.
	1004-00-01	Switch Board (Arm) Keypad	1.0
	70102	Screw 4-40 x 1/4 Phil Lock	3.0
	85005	Filter .060 5.3x4.125"	1.0
	85004	Optrex 5.7"DMF50840NFFW-ABE-AU	1.0
	72250	Spacer #6 x 5/16 Aluminum	4.0
	71300	Nut 6-32 Lock	4.0
	72302	Spacer Nylon #6 3/16THK .2500	2.0
	81000	Rt. Angle Front Bracket	2.0
	71100	Nut 4-40 Lock	2.0
	1003-02-01	LCD Interface Contrast Board	1.0
	80003	SmartArm Front Panel	1.0
	8003-00-01	Painted SmartArm Top	1.0
	86003	SmartArm Switch Fab LCD Rev C	1.0
	81000-1	Front Panel Bracket	2.0
	87505	Serial Number Label	1.0

LCD Interface PCB (P/N 1003-02-01)

Ref. Des.	Part No.	Description	Qty.
C5	11006	27uF 35V CAP	1.0
R22	22006	510 ohm 5% 1/8W	1.0
R20	22007	10 ohm 5% 1/8W	1.0
R16	22008	20K 5% 1/8W	1.0
R21	22009	47K 5% 1/8W	1.0
VR2	24004	10mm POT 10K THUMBWHEEL	1.0
Q3	52000	2N2222A (TO92)	1.0
R14, JP2, JP1 pins 2+3	60003	3 PIN JUMPER BUSS WIRE	3.0
J6	61010	3 PIN TALL HDR (36 PIN STRIP)	1.0
J4	61011	3 PIN PASSTHRU MOLEX	1.0
J3	61012	4 PIN1 ROW .1 HEADER (strip)	1.0
J2	63002	HEADER 8X2 PROTECTED RT	1.0
J1	63006	VERT.MNT. CONNECTOR	1.0
	70200	SCREW 2-56x3/16 Phillips	2.0
	71001	NUT 2-56 MACHINE	2.0
	72200	Spacer 2-56x3/8+1/8Thrd Alum.	2.0
M1	85006	24V INVERTER	1.0
(PowerModule R6)	20035	17.8K 1% 1/4W	1.0

SmartArm Bottom Assembly (P/N 2004-00-01)

Ref. Des.	Part No.	Description	Qty.
	75004	Foot 13/32 Rubber w/Washer	5.0
	70103	Screw 4-40x3/8 Phil Lock	5.0
	75003	Plastic Foot 0.44	3.0
	70302	Screw 6-32x1/2 Torx	4.0
	72300	Spacer #6 1/32 Nylon	3.0
	71300	Nut 6-32 Lock	3.0
	56002	Fitting 1/8 Barb:O-Ring Bulkhd	1.0
	70500	Screw 10-32x1/2 Allen Flathead	1.0
	74601	Corrugated Tubing	1.0
	75002	Clamp Nylon 3/8 Loop	1.0
	70102	Screw 4-40 x 1/4 Phil Lock	1.0
	75005	SA Handle-complete set	1.0
	70101	Screw 4-40x1/2 Phillips	2.0
	71100	Nut 4-40 Lock	2.0
	71101	Nut 4-40 Small Pattern	2.0
	66000	Ribbon Cable 10 Pin 14 In	1.0
	66003	Pump Choke Polarized Cable	1.0
	80002	SmartArm Bottom	1.0
	8002-00-01	Painted SmartArm Bottom	1.0
	70106	Screw 4-40x1/2 Torx	3.0
	70100	Screw 4-40 x 1/2 Phil Lock	1.0

Bulkhead Assembly (P/N 2002-00-01)

Ref. Des.	Part No.	Description	Qty.
	50000	IRF530 N Channel	1.0
	70104	Screw 4-40x3/8 Phil	1.0
	72101	Spacer #4 1/4 Hex Nylon	1.0
	70103	Screw 4-40x3/8 Phil Lock	1.0
	57100	Check Valve-Norgren	1.0
	56006	Fitting 1/8-1/8-1/8 Tee	2.0
	56003	Fitting 1/8 Barb:Female O-Ring	2.0
	84006	Poron Tape 3/4Wx1/8T	0.5
	84000	Battery Pack 16 Cell	1.0
	84004	Foam Tape 1x1/16 Sponge Rubber	0.5
	80005	Pump Bracket	1.0
	66003	Pump Choke Polarized Cable	1.0
	54000	100uH Choke (coil)	2.0
	10000	0.01uF Cap (10,000pF)	1.0
	76001	Heat Shrink 3/8 x 10 ft	1.0
	75000	Clamp Nylon Loop 1 1/8	2.0
	71300	Nut 6-32 Lock	2.0
	75006	Nylon Cable Tie 4 in	2.0
	68009	Pins, Female Molex For.1 (100)	4.0
	60014	2 Pin Polarized .1 Housing	1.0
	56001	Fitting 1/8 Barb:10-32 (10pk)	3.0
	73500	Washer 10-32 Fiber Gasket	1.0
	75600	Thermal Pad T220	1.0
	80001	Bulkhead	1.0
	71100	Nut 4-40 Lock	7.0
	84008	Solenoid 3 Way 6V	2.0
	70301	Screw 6-32x3/8 Phillips	4.0
	60002	3 Pin Molex Polarized Hdr	1.0
	80000	Battery Bracket	2.0
	72103	Stepwasher #4 Transistor Mount	1.0
	74300	Tubing 1/8ID x 1/4OD Tygon	1.0
	84006-1	Pump 24V Diaphragm	1.0

Switch Panel PCB (P/N 1004-00-01)

Ref. Des.	Part No.	Description	Qty.
D9	43000	LED (SWITCH BD)	1.0
JP12	61001	5X2 PIN PROTECTED HEADER	1.0
R20	20006	1.00K 1% RESISTOR	1.0
S1	46000	SWITCH PUSH BUTTON RED	1.0
S2,S3,S4,S5,S6	46001	SWITCH PUSH BUTTON BLACK	5.0

Power Converter PCB (P/N 1002-00-01)

Ref. Des.	Part No.	Description	Qty.
C11	10000	0.01uF CAP	1.0
C9,C13,C14	11005	0.1uF 50V CAP	3.0
C6,C7,C12,C16	11003	1.0uF 50V CAP	4.0
C15,C17	11006	27uF 35V CAP	2.0
C3,C5	11002	120uF 35V CAP	2.0
C10	11004	220uF 25V CAP	1.0
C1	11001	330uF 16V CAP	1.0
D7,D9	41000	DIODE 1N4001	2.0
D1,D3,D4,D8	41001	DIODE 1N5819 SCHOTTKY	4.0
JP8	60000	2 PIN HEADER	1.0
JP5,JP6,JP9	60001	2 PIN POLARIZED HEADER	3.0
JP7	60002	3 PIN POLARIZED HEADER	1.0
JP2	60003	3 PIN JUMPER BUSS WIRE	1.0
JP1	63004	10X2 0.5 PWR HEADER	1.0
L1	54001	220uH CHOKE	1.0
L2	54002	2200uH CHOKE	1.0
PD1	75600	THERMAL PAD T220	1.0
Q3,Q5,Q6,Q9,Q11	52000	TRANSISTOR 2N2222A	5.0
Q7	50000	TRANSISTOR IRF530 N CHANNEL	1.0
Q8	51000	TRANSISTOR 2N2907A	1.0
R22	22001	0.62 1W SHRINK RESISTOR	1.0
R1,R2,R14,R15	20006	1.00K 1% RESISTOR	4.0
R3	20017	3.09K 1% RESISTOR	1.0
R18	20005	5.6K 1% RESISTOR	1.0
R6,R17	20004	15.4K 1% RESISTOR	2.0
R19,R23	20001	82.5K 1% RESISTOR	2.0
R20,R25	20002	453K 1% RESISTOR	2.0
R16,R21,R24	20000	1M 1% RESISTOR	3.0
RN1	23000	56KX7 RESISTOR PACK	1.0
RN2,RN3	23003	100K 3 ISO RESISTOR PACK	2.0
U1,U3	32000	IC LM2575HVT-ADJ	2.0
U5	32004	IC LM7815	1.0
U6	32002	IC LM2936Z-5.0	1.0
U7	30000	IC ICM7556	1.0
U8	30001	IC 74HC74	1.0
U9	30002	IC LP324	1.0

CPU PCB (P/N 1000-00-01)

Ref. Des.	Part No.	Description	Qty.
	1000-00-01	SmartArm Main Board	1.0
	32006	LT1101CN8	1.0
	35000	F8680-14A 5V asiliant	1.0
	35001	62256 SRAM 256K=32Kx8 (Pkg 26)	1.0
	35002	514256 DRAM 1M=256Kx4 SOJ26	2.0
	35003	PLCC Socket 32 Pos SMT	1.0
	35006	UPD71055L (NEC)	1.0
	35007	16C451 (16C452)	1.0
	35008	MAX232CWE (Wide SOIC RS-232)	1.0
	35009	74HCU04	1.0
	35010	74HCT04D (SO-14)	1.0
	35011	74HCT74	1.0
	35012	SN74HCT138D	1.0
	35013	74HCT174 (SO16)	2.0
	35014	74HC4051	1.0
	37000	LM324D (Tubes)	6.0
	37001	LF347D	1.0
	37002	LM78L05ACM	1.0
	37003	LM79L15ACM	1.0
	37004	ADS774JU	1.0
	37005	AD7628KP	1.0
	37006	DAC-312HS	1.0
	37007	DG444DY	1.0
	41001	1N5819 Schottky	1.0
	41003	1N5822 Schottky (100Pk)	1.0
	43001	LED (MB Mount)	1.0
	45000	14.31818mHZ (HC-49S)	1.0
	45001	1.8432mHZ (HC-49U)	1.0
	45100	Crystal Spacer, Ribbed Mylar	2.0
	55000	FPM-07PG Pressure Sensor	1.0
	21000	3.6K 5% 1/2W Resistor	1.0
	22000	0.50 1% 5W Resistor	1.0
	26003	453 1% Resistor	1.0
	26004	825 1% Resistor	1.0
	26005	909 1% Resistor	1.0
	26007	2.49K 1% Resistor	2.0
	26008	4.87K 1% Resistor	2.0
	26009	4.99K 1% Resistor	2.0
	26010	8.25K 1% Resistor (Reel)	1.0
	26011	8.45K 1% Resistor	1.0
	26014	22.6K 1% Resistor	1.0
	26015	37.4K 1% 100PPM 1206 1/4w	2.0
	26016	40.2K 1% Resistor	6.0
	26017	52.3K 1% Resistor	2.0
	26018	332K 1% Resistor	1.0
	26042	2.21K 1% 100ppm 1206	1.0
	26043	2.67K 1% 1206 Resistor	1.0
	26044	6.65K 1% 1206 Resistor	1.0
	25000	7x33 Resistor Pack	2.0

25001	10K 9 Com Resistor Pack	3.0
29001	100 1 Turn Pot	2.0
29002	200 1 Turn Pot	1.0
13000	0.22uF Cap	6.0
13001	1.0uF 63V 5% Metalpoly	1.0
15000	39pF Cap (Reel 1000)	5.0
15001	2200pF Cap	1.0
16000	0.22uF Cap	1.0
17000	10.0uF 16V Tant (6032 or C)	7.0
17001	22.0uF 10V Tant (5633 or C)	3.0
60001	2 Pin Polarized HDR. (Molex)	1.0
60002	3 Pin Molex Polarized Hdr	1.0
60010	2mm DC Input Jack	1.0
60011	3 Pin T0-220 Socket (Molex)	1.0
61002	DB9 PIN Connector Female	1.0
61004	6 Pin Header 36 Pin Strip	1.0
61005	Header 5x2 Protected Right	1.0
63001	10x2 Header Tall (Samtec)	1.0
63002	Header 8x2 Protected Right	1.0
64000	DB25 Conn. Female .318 Mnt.	1.0
75009	Test Point (Keystone 5001)	4.0
86000	Main Board (ARM/ARM)	1.0
1700-00-11	Datasheet - Motherboards	1.0
66005	Servo Cable Rev B 10"	1.0
50000	IRF530 N Channel	1.0
35015	Atmel Flash Eeprom	1.0
1006-00-01-A	PID Servo Controller (ARM)	1.0

PID / Servo Controller PCB (P/N 1006-00-01) Rev. 3.0

Ref. Des.	Part No.	Description	Qty.
C1_NEW	10002	1,000pf *mount on back Mount across JP4 pins 1+2 on back of board	1
C3, C2	13001	1.0uF, 5% M.P. *special mounting One leg in C2 hole farthest fromU3, other leg in C1 hole closest to U3, Bend leg for C1 hole only, there is a clearance issue the other way.	2
C4	13004	0.1uF, 5% M.P.	1
R2	20044	1.00K	1
R12	20006	14.7K	1
R10	20045	4.12K	1
R1, R6, R7, R9	20041	24.9K	4
R15	20046	32.4K	1
JP2, JP3	21501	0.1” JUMPER (PINS 2+3)	2
R3, R4, R5, R8, R11,R13	21502	0.2” JUMPER (PINS 2+3)	6
U3	30002	LP324N	1
U2	32003	LF442N	1
JP1	61003	6 Pin Bottom Entry Socket	1
JP4	61013	3 Pin Rt. Angle Header	1

Section 15. Schematic Diagrams

INTRODUCTION

This section provides part locator diagrams and electrical schematic diagrams for the **Smart**Arm's five printed circuit boards:

- Power Converter PCB
- CPU PCB
- LCD Interface PCB
- Switch Panel PCB

POWER CONVERTER PCB

Power Converter PCB Part Locator Diagram

Power Converter PCB Schematic Diagram

CPU PCB

CPU PCB Part Locator Diagram

CPU PCB Schematic Diagram

LCD INTERFACE PCB

LCD Interface PCB Part Locator Diagram

LCD Interface PCB Schematic Diagram

SWITCH PANEL PCB

Switch Panel Part Locator Diagram

Switch Panel Schematic Diagram