


| REV. | ZONE | ECO # | REVISION | APPD | DATE |
|------|------|-------|---|-----------|-------|
| A | | D258 | Initial Release | <i>MA</i> | 10/83 |
| B | | D304 | Changed Section 6.0 to show characteristics of new IC. Changed Section 10.2 Static Discharge description. Changed pages 11,12,13,14 and 15 to "APPENDIX" ref. instead of "FIGURE" references. | | |

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| | | | | |
|--|-----------------------------------|------------------------------|---|---|
| TOLERANCES UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. DECIMALS .X ± _____ .XX ± _____ .XXX ± _____ ANGLES XX.X ± _____ FRACTIONS ± _____ DIMENSIONS IN PARENTHESIS ARE IN MILLIMETERS. | DRAWN BY M. Aguirre | DATE 9/13/83 |  apple computer inc. | |
| | CHECKED BY <i>[Signature]</i> | DATE 9/13/83 | | TITLE Engineering Specification for Macintosh Keyboard |
| | APPROVED BY <i>[Signature]</i> | DATE 10/20/83 | | |
| | RELEASED BY <i>[Signature]</i> | DATE 10/20/83 | | |
| MATERIAL: _____ | SIZE A | DRAWING NUMBER 062-0161-B | | |
| NEXT ASSY. FINISH: _____ | SCALE: _____ | SHEET 1 OF 15 | | |

1.0 TITLE: Engineering Specification Macintosh Keyboard

2.0 PURPOSE: The purpose of this document is to define the design electrical, mechanical, testing, packing, safety and reliability requirements for the Macintosh keyboard.

2.1 RESTRICTIONS: Materials and construction of production keyboards must be identical to qualifying pieces. No deviation is allowed without written authorization from Macintosh Division Engineering.

2.2 CONFLICTS: Where discrepancies between this specification, other referenced specifications and Macintosh keyboard documentation are in conflict, the following is the order of precedence:

1. Macintosh Keyboard Documentation
2. This Specification
3. Other Reference Specifications

3.0 TABLE OF CONTENTS:

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4.0 APPLICABLE AND REFERENCE DOCUMENTS:

COSMETIC AND QUALITY SPEC. FOR PLASTIC PARTS #062-2006
COSMETIC AND QUALITY SPEC. FOR KEYCAPS #062-2007
KEYCAP COSMETIC SPEC. #068-0053
THERMOSTATIC PRINTED KEYCAP SPEC. #062-0142
PRINTED CIRCUIT BOARD SPEC. #062-0031
WORKMANSHIP STANDARD ↓ PC BOARDS ASSEMBLY #062-0012
EMI #062-0088
TEMPERATURE AND HUMIDITY #062-0089
LINE VOLTAGE AND FREQUENCY VARIATION #062-0092
SHOCK AND VIBRATION VALIDATION TESTING #062-0086
PACKAGING FINISHED GOODS SHOCK AND VIBRATION #062-0087
SAFETY STANDARDS #062-0093
SCHEMATIC #050-0068

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5.0 FUNCTIONAL DESCRIPTION

- 5.1 The Macintosh keyboard is a stand-alone keyboard, which connects to the computer by a coil cord. The keyboard communicates with a Macintosh Computer via a two-wire synchronous serial interface, where the initiative for communication alternates between the two devices. This scheme is known as a token-passing protocol in that each device may "speak" only when it has been given permission to do so (i.e., the token) by the other device. All transactions are eight bits, most significant bit (MSB) first. Bit 7 of a key change byte is "0" for a key down, "1" for a key up.
- 5.2 The Serial Bus: The four-wire coil cord carries +5V, GND, DATA and CLOCK. The DATA wire is bi-directional and is driven alternately by the Mac and by the 8021. The CLOCK wire is driven only by the 8021. When the 8021 issues its 8 low-going clock pulses to obtain a new token, Mac presents its bits (MSB first) upon the falling edge of the clock and 8021 captures them slightly after the subsequent rising edge. (Since Mac gets its interrupt on the eight falling edge, it must delay before turning the line around so as not to catch that last rising edge.) Similarly, when the 8021 replies, it presents its 8 bits (MSB first) slightly before the falling edge of the clock, and Mac captures them upon the subsequent rising edge.
- 5.3 The Protocol: Upon power-up of either Mac or the keyboard or both, the "token" resides with the Mac. The Macintosh indicates that it is ready to send a command by holding the DATA line low; the 8021 then clocks out this command token. The Mac then turns the DATA line around, leaving it high to indicate that it is now in input mode. If the keyboard does not reply within 1/2 sec. (approximately) then Mac assumes it has been unplugged and re-initializes (i.e., sets up to re-send the token). Having received a valid token, the 8021 will always try to reply within 1/4 sec., but only if the data line is high. If the DATA line stays low or if the 8021 receives an invalid token, it will time out and try to clock out a new token. If the 8021 does not have the token, it will wait forever for the DATA line to go low.
- 5.4 The Tokens: There are four tokens, one byte each. If bit 7 of a token is set, it means that the 8021 is to "pass it through" to the next daisy-chained device, if any. Bit 0 is always "0" so that the DATA line is left low until it can be turned around for input. Similarly, on all replies from the keyboard, bit 0 is a "1" to leave the line high until it is turned around.



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- 5.5 Normal token (10 hex): The 8021 will send key changes as they occur, or a null (7B hex) after approx. 1/4 sec. if no key changes have occurred.
- 5.6 Instant token (14 hex): The 8021 will send either a key change, if it has found one, or a null, immediately.
- 5.7 Test token (36 hex): The 8021 will test its 64 bytes of internal RAM (first with '55's, then 'AA's). If the test passes, an ACK (7D hex) is sent; if not, a NACK (77 hex).
- 5.8 Model Number token (16 hex): the 8021 will immediately send its model number, composed as follows:

Bit 0 : always '1' (to leave line high)
 Bit 1-3: keyboard model number 1-8
 Bit 4-6: optional daisy-chained device number 1-8
 (e.g., numeric keypad)
 Bit 7 : '1' = another external device is connected.

This token also clears RAM (to re-send alpha lock key)

- 5.9 The 8021 code limits rollover to two (2) keys (third and subsequent keys are locked out) to eliminate "phantom" or "ghost" keystrokes.

6.0 ELECTRICAL REQUIREMENTS

- 6.1 8021: One of the two active electrical components of the keyboard are the 74LS123 one-shot and the 8021 one-chip microcomputer. 8021's to be used in a Macintosh keyboard are expected to conform to the characteristics outlined on the 8021 specification (#062-2009) which have been summarized as follows:

8021 D.C. Characteristics:

Vcc 5.0V +/- 10%
 Icc 30 mA. typ., 60 mA. max.
 Voh 2.4V, min. @ Ioh=40 uA.
 Vol .45V max. @ Iol = 1.6 mA.
 Vih 2.0V min.
 Vil 0.8V max.



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8021 A.C. Characteristics:

| | | |
|------|------------------------|-------------------|
| Tpl | output data setup time | .6 us. min. |
| Tlp | output data hold time | .6 us. min. |
| Tprl | input data setup time | 4 us. max. |
| Tpfl | input data hold time | 0 us. |
| Tr | reset high | 3 cycles (30 us.) |

Oscillator frequency:

3 Mhz +/- 5% (over rated temp)

Instruction cycle time: 10 us (@3 MHz)

- 6.2 74LS123: The second active electrical component used on the Macintosh keyboard is the 74LS123 "one shot" timer. This IC is also expected to conform to the characteristics outlined on the 74LS123 specification (305⁺0123), which have been summarized as follows:

LS123 D.C. CHARACTERISTICS:

| | |
|-----|--------------------------|
| Vcc | 5V +/- 5% |
| Icc | 12 mA. typ., 20 mA. max. |
| Voh | 2.7V min. @ Ioh=400 uA. |
| Vol | .5V max. @ Iol=8 mA. |
| Vih | 2.0V min. |
| Vil | 0.8V max. |

LS123 A.C. CHARACTERISTICS:

| | | |
|------|-----------------------------------|--------------------------|
| Tplh | prop. delay, low-to-high | 23 ns. typ., 44 ns. max. |
| Tphl | prop. delay, high-to-low | 33 ns. typ., 56 ns. max. |
| Tw | pulse width = 0.45 . Rext . Cext. | |

Q1 times out ~90 ms. after strobe has stopped, triggering Q2 (reset), which lasts ~9 ms.



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7.0 MECHANICAL REQUIREMENTS:

7.1 Keyboard must conform mechanically to all applicable cosmetic, mechanical and reliability specifications and or drawings, referenced in this specification or listed on the Bill of Materials.

8.0 PRODUCT DESIGN/GENERAL SPECIFICATION

8.1 KEYBOARD HOUSING

- 8.1.1 Must be per current Engineering Released top and bottom housing drawings part numbers #815-0728 and 815-0754.
- 8.1.2 Top and bottom housing must conform to Cosmetic and Quality spec. #062-2006.
- 8.1.3 Color to be Apple beige, per Color Control Panel # 912-0020.
- 8.1.4 Texture to be per Apple spec's #062-2004 and 062-2002. Refer to Engineering drawings for different texture locations.

8.2 KEYCAPS

- 8.2.1 All keycaps must conform to Apple Cosmetic and Quality spec's #062-2007 and 062-0053.
- 8.2.2 Color to be Apple Medium Brown per Color Control Panel # 912-0021.
- 8.2.3 Texture: Top per MT1055-2
Sides per MT1055-4
- 8.2.4 Each keycap must be able to resist a 3 pound pull force without detaching from keyswitch.
- 8.2.5 Printed keycap locations should be per Keycap Set drawing (See sheet 13, Appendix 15.1.4)
- 8.2.6 Line width, legend position, color and physical requirements of printed keycaps to be per Thermostatically Printed Keycap Spec. #062-0142 and individual printed keycap drawings. (Ref. Bill of Materials)



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8.3 COIL CORD

8.3.1 TYPE: 4 conductor, 28 AWG. 7/32 stranded (Ref. drawing 590-0144).

8.3.2 Connectors: 4-pin RJ-11 type Modjack on each end, with non-reversing pinout end-to-end.

Resistance: 3 ohms max. (each conductor)

Capacitance: 150 pF max. (each conductor to the other 3 tied together)

8.3.3 Cable flex life: The cable shall survive 100,000 cycles, flexed 45 degrees each way over a 1" (25.4 mm) mandrel at 30 cycles per minute.

8.4 KEYSWITCHES

8.4.1 Each keyswitch must operate smoothly with no evidence of binding over its entire travel.

8.4.2 Types of keyswitches used are momentary (SPST) and self-locking.

8.4.3 Keyswitch spring force must follow the attached force/travel curve within $\pm 20\%$ at equivalent stem displacement. Exception is allowed in the area of "tactile" (negative spring rate) force characteristics where like force features must be within $\pm 20\%$ of the attached curve and these like features must not vary more than $\pm 15\%$ in displacement from the reference curve.

8.4.4 Switch contact make/break mechanical hysteresis must be greater than .1 mm stem displacement or greater than 4 grams force differential to minimize "teasability".

8.4.5 Keyswitch resistance: open 50 megohms min.
closed 300 ohm max.

8.4.6 Switch Life: The keyswitches shall be wired to a resistive circuit supplying a current of 2mA. @ 5V DC and operated a total of 10 million cycles at a rate of approximate 10 closures per second. Following this test, the keyswitch shall satisfy the complete Electrical Specification of the Document.

8.4.7 Keybounce on all switches (except alternate action) must be less than 5 milliseconds. Keybounce is defined as the length of time for the voltage across the switch to settle to above 90% of its final open circuit value when released and under 10% of its final short circuit value when closed. (Open voltage \neq Short voltage = 100%).

8.4.8 All keyswitches shall meet Apple Temperature and Humidity Spec. #062-0089, after Life Testing.



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8.5 KEYSWITCH PLATE

- 8.5.1 Must be per current Engineering released drawing (Ref. Bill of Materials).
- 8.5.2 Material: Cold rolled steel, C⁺010 ASTM⁺A⁺366, 1.22mm +0.00mm -0.10mm thick.
- 8.5.3 Plate to be identified with part number and current revision.

8.6 PRINTED CIRCUIT BOARD

- 8.6.1 Single sided
- 8.6.2 Material: CEM-1, 1oz. copper or equivalent.
- 8.6.3 PCB to be fabricated per Engineering released drawing and Apple PCB specification #062⁺0031.
- 8.6.4 PCB must be identified with Apple Logo, copyright date and manufacturer logo and date code.

8.7 INTEGRATED CIRCUITS

- 8.7.1 Must be tested and burned⁺in per Apple specification #062⁺2009.
- 8.7.2 IC must have Apple part no. and vendor ID# per the engineering released specification #342⁺0222.
- 8.7.3 Leads must be solderable per EIA STD. RS⁺186⁺9E.

8.8 DISCRETE COMPONENTS


- 8.8.1 All components must conform to engineering released documentation.
- 8.8.2 Component placement shall conform to Apple Workmanship Standard PC board assembly #062⁺0012.
- 8.8.3 Components shall be at least .175" (4.45mm) from outer edge of PCB and minimum spacing between components centers shall be .150" (3.81mm).
- 8.8.4 Leads and eyelets must be solderable per EIA STD. RS⁺186⁺9E.

8.9 JUMPERS

- 8.9.1 Must be 22 guage tin plated annealed copper per Federal Spec. QQ⁺W⁺343. They shall be parallel to each other and if possible aligned with the "Y" axis. All jumpers will be 1/2" (12.7mm) in length unless otherwise specified.

8.10 SOLDER WORKMANSHIP

- 8.10.1 Soldering workmanship must comply to Apple Keyboard Workmanship Standards.

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9.0 KEYBOARD TEST REQUIREMENTS

- 9.1 The keyboard shall be tested to ensure the requirements of this specification ⁴ Ref. Macintosh Keyboard Test Specification 062-0159.

10.0 ENVIRONMENTAL AND RELIABILITY REQUIREMENTS

- 10.1 The keyboard shall conform to the following Apple environmental and reliability class 1 specifications:

- 10.1.1 Temperature and Humidity #062-0089
- 10.1.2 Line voltage and frequency variation, #062-0092
- 10.1.3 Shock and Vibration, #062-0086

- 10.2 Static Discharge: The keyboard shall withstand 30 ESD sparks minimum to any location which can draw an arc, for all of the following conditions:

- 1). Test generator: Andy Hisk ESD-255, with P255-1 probe.
- 2). Voltage levels: 2.5KV, 5.0KV, 7.5KV, 10KV, 12.5KV, and 15KV.
- 3). Unit to be placed on 2" high insulator; placed on 36" x 36" radiating plate antenna structure.
- 4). Arcs applied no faster than once every three (3) seconds.

Sparks to keyboard or to plate shall not cause irreversible component failure. For voltage levels up to 10KV, stuck keys or keyboard lockup shall not occur. Hits to the computer shall not cause damage to the keyboard.

- 10.3 Following an application of a shock of 50g's in accordance with method 213B, Test Condition A, Mil-Std-202F, there shall be no defect in appearance or keyboard operation.

- 10.4 Following the vibration test, conducted in accordance with method 201A, Mil-Std-202F, there shall be no defects in appearance or keyboard operation.

11.0 PRODUCT SAFETY

- 11.1 Keyboard should conform to Apple Safety specification #062-0073.

12.0 EMC COMPATIBILITY:

- 12.1 Keyboard must meet Apple Class B RFI emission standards for home electronic devices when connected to a Macintosh. (Ref. Spec. #062-0088).



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13.0 PACKAGING

- 13.1 Packaging should be designed to conform to Apple Packaging Finished Goods Shock and Vibration Spec. #062-0087.
- 13.2 Keyboard must have proper ID/Serial number labels attached.
- 13.3 Packaging of keyboard should be per Engineering released drawing (Ref. Bill of Materials).

14.0 QUALITY ASSURANCE PROVISIONS

- 14.1 Quality Assurance shall guarantee that the completed product meets the requirements of this specification.
- 14.2 The Macintosh keyboard must meet the standards of all reference documents as listed in paragraph 4.0 except a noted in paragraph 2.2

15.0 APPENDIX

- 15.1 Attached documents
 - 5.1.1 Force/Travel Curve
 - 5.1.2 Table of Keyboard Key Codes
 - 5.1.3 Serial Bus Timing Diagram
 - 5.1.4 Keycap legend layout
 - 5.1.5 Schematic



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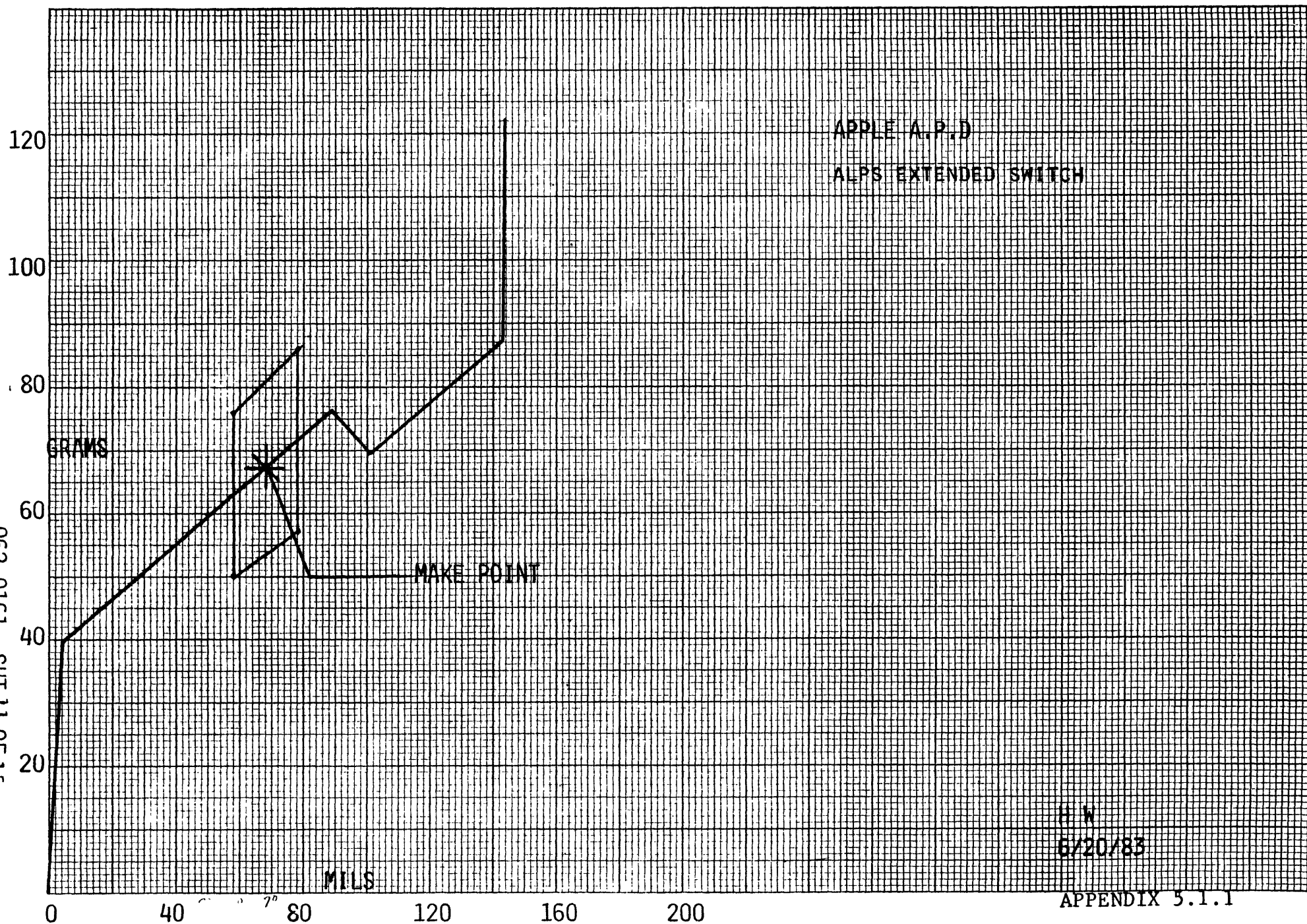
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APPENDIX 5.1.1

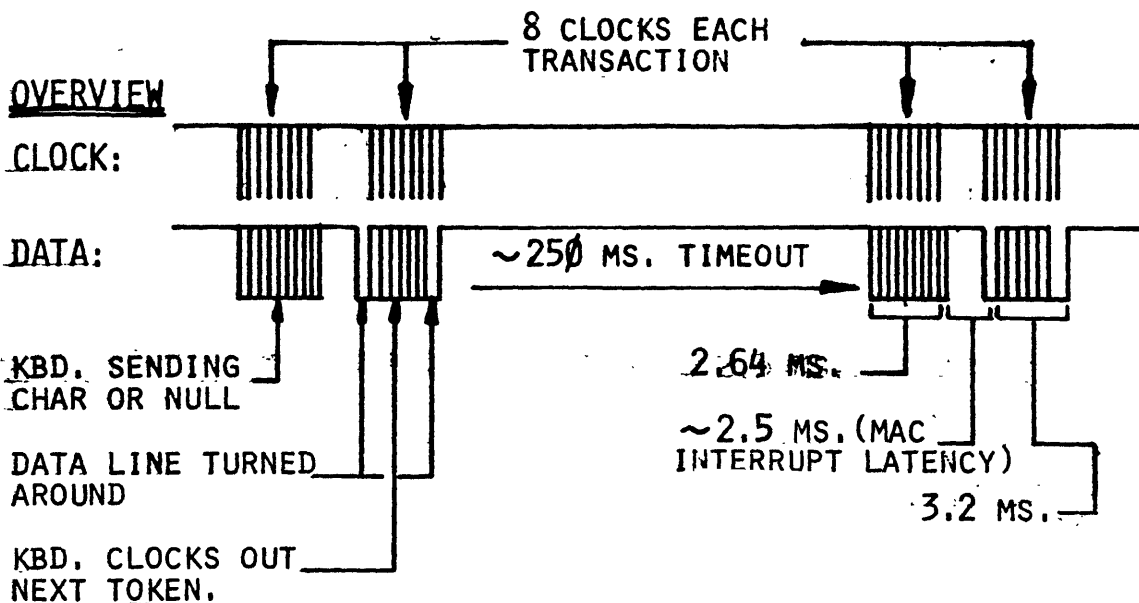
MACINTOSH KEYBOARD KEYCODES

When the keyboard sends a byte to Macintosh bit 0 is always set (to a '1') to leave the data line high. Bit 7 is a '1' for key-up, a '0' for key-down. This leaves 6 bits left for the keycode, giving a total of 64 possible keycodes.

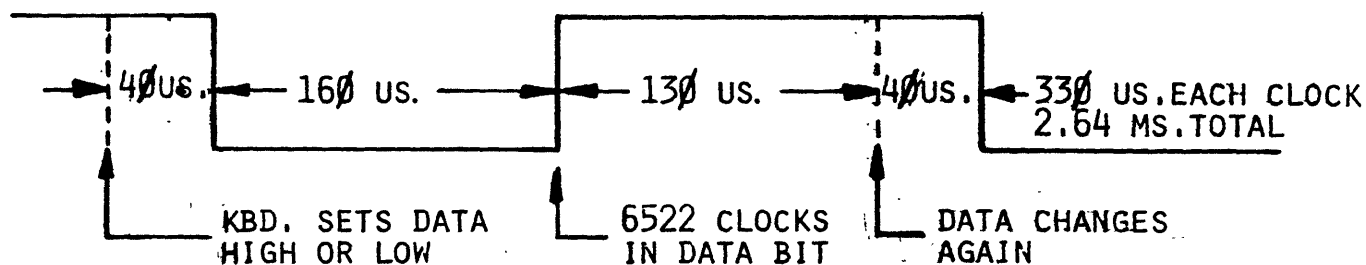
| CODE | KEY | CODE | KEY | CODE | KEY | CODE | KEY |
|-------|-----|-------|-----|-------|-----|-------|-----------|
| ----- | | ----- | | ----- | | ----- | |
| 01 | A | 21 | Y | 41 | U | 61 | TAB |
| 03 | S | 23 | T | 43 | [| 63 | SPACE |
| 05 | D | 25 | 1 | 45 | I | 65 | (accent) |
| 07 | F | 27 | 2 | 47 | P | 67 | BS |
| 09 | H | 29 | 3 | 49 | RET | 69 | ENTER |
| 0B | G | 2B | 4 | 4B | L | 6B | |
| 0D | Z | 2D | 6 | 4D | J | 6D | |
| 0F | X | 2F | 5 | 4F | ' | 6F | COMMAND |
| | | | | | | | |
| 11 | C | 31 | = | 51 | K | 71 | SHIFT |
| 13 | V | 33 | 9 | 51 | ; | 73 | CAPS LOCK |
| 15 | | 35 | 7 | 55 | \ | 75 | OPTION |
| 17 | B | 37 | - | 57 | , | 77 | NAK |
| 19 | Q | 39 | 8 | 59 | / | 79 | KPD.ESC. |
| 1B | W | 3B | 0 | 5B | N | 7B | NULL |
| 1D | E | 3D | } | 5D | M | 7D | ACK |
| 1F | R | 3F | 0 | 5F | . | 7F | |
| ----- | | ----- | | ----- | | ----- | |

Codes 01 through 6B apply to keys in the matrix. Codes 6F through 75 represent the special keys not in the matrix. Codes 77 through 7D represent software-generated codes used in the communications protocol.

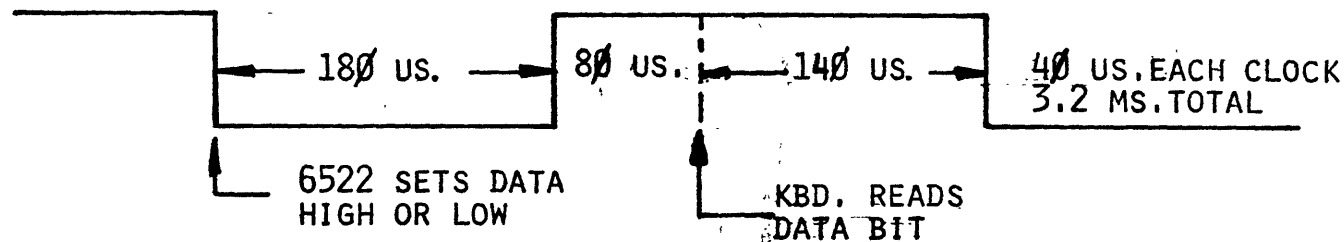
APPENDIX 5.1.2



CLOCK TIMING FOR KBD. SENDING CHAR. (ONE OF EIGHT LOW-GOING CLOCKS)



CLOCK TIMING FOR KBD. CLOCKING OUT TOKEN (ONE OF EIGHT LOW-GOING CLOCKS)



ALL TIMES ASSUME 10 us. CYCLE TIME (3MHZ OSCILLATOR) FOR 8021.
 PROTOCOL SUMMARY:

8021 WON'T CLOCK OUT TOKEN UNLESS DATA IS LOW. LAST BIT OF TOKEN=0 TO LEAVE DATA LINE LOW. WHEN MAC. TURNS LINE AROUND FOR INPUT, LEAVES DATA LINE=1

8021 WON'T SEND CHAR. UNLESS DATA IS HIGH. LAST BIT OF CHAR.=1 TO LEAVE DATA LINE HIGH. WHEN MAC. TURNS LINE AROUND FOR NEW TOKEN, DATA IS LEFT = 0

- 1.0 TITLE: ENGINEERING SPECIFICATION FOR MACINTOSH KEYBOARD
- 2.0 SCOPE:
- 2.1 THIS DOCUMENT WILL DEFINE:
1. ELECTRICAL AND MECHANICAL DESIGN
 2. FUNCTIONAL REQUIREMENTS FOR HOST COMPUTER (MACINTOSH)
 3. SAFETY AND RELIABILITY REQUIREMENTS
 4. PACKAGING SPECIFICATIONS
- 2.2 MATERIALS AND CONSTRUCTION OF PRODUCTION KEYBOARDS MUST BE IDENTICAL TO QUALIFYING PIECES. NO DEVIATION IS ALLOWED WITHOUT WRITTEN AUTHORIZATION FROM MACINTOSH DIVISION ENGINEERING.
- 2.3 ORDER OF PRECEDENCE FOR AUTHORIZED DOCUMENTATION:
1. MACINTOSH KEYBOARD DOCUMENTATION
 2. THIS SPECIFICATION
 3. REFERENCE DOCUMENTS

3.0 TABLE OF CONTENTS:

| PARAGRAPH | SUBJECT |
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| 4.0 | REFERENCE SPECIFICATIONS AND DOCUMENTS |
| 5.0 | INTERCONNECTION |
| 6.0 | COMMUNICATION PROTOCOL |
| 7.0 | KEY ROLLOVER |
| 8.0 | KEY CODES |
| 9.0 | KEY SWITCH CHARACTERISTICS |
| 10.0 | COIL CORD |
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4.0 REFERENCE SPECIFICATIONS AND DOCUMENTS

| | |
|----------|--|
| 050-0068 | SCHEMATIC |
| 050-0120 | SCHEMATIC |
| 062-0012 | WORKMANSHIP STANDARD, PC BOARDS ASSEMBLY |
| 062-0031 | PRINTED CIRCUIT BOARD SPEC. |
| 062-0053 | KEYCAP COSMETIC SPEC. |
| 062-0086 | SHOCK AND VIBRATION VALIDATION TESTING |
| 062-0087 | PACKAGING FINISHED GOODS SHOCK AND VIBRATION |
| 062-0088 | EMI |
| 062-0089 | TEMPERATURE AND HUMIDITY |
| 062-0093 | SAFETY STANDARDS |
| 062-0142 | THERMOSTATIC PRINTED KEYCAP SPEC. |
| 062-2002 | TEXTURE |
| 062-2004 | TEXTURE |
| 062-2006 | COSMETIC AND QUALITY SPEC. FOR PLASTIC PARTS |
| 062-2007 | COSMETIC AND QUALITY SPEC. FOR KEYCAPS |
| 062-XXXX | ESD |
| 590-0144 | COIL CORD |
| 705-0070 | KEYBOARD SWITCH |
| 705-0077 | SELF-LOCKING SWITCH |
| 815-0728 | TOP HOUSING |
| 815-0754 | BOTTOM HOUSING |
| 912-0020 | COLOR CONTROL PANEL |
| 912-0021 | COLOR CONTROL PANEL |

5.0 INTERCONNECTION

5.1 CONNECTOR P1

| | |
|--------------|--------------------------|
| PIN 1 (CGND) | CHASSIS GROUND |
| PIN 2 (KBD1) | KEYBOARD CLOCK LINE |
| PIN 3 (KBD2) | BI-DIRECTIONAL DATA LINE |
| PIN 4 (KPWR) | +5V +/- 10% @80 mA MAX |

5.2 SIGNAL LEVELS

5.2.1 DATA LINE (INPUT/OUTPUT)

| | |
|--------------------|-----------------------|
| LOGIC ONE | 2.4V MIN @-100 uA MIN |
| LOGIC ZERO | 0.4V MAX @1.6 mA MAX |
| RISE AND FALL TIME | 1.0 uS MAX |

5.2.2 CLOCK

| | |
|-----------------|------------------------|
| V _{OH} | 2.4V MIN @ -25 uA MAX |
| V _{OL} | 0.4V MAX @ 0.25 mA MAX |

6.0 COMMUNICATION PROTOCOL

6.1 DATA FORMAT

6.1.1 SERIAL SYNCHRONOUS, 8 BITS PER CHARACTER

| | <u>KEY CODE</u> | <u>TOKEN</u> |
|--------------------------|--------------------------|----------------------------|
| BIT 7 - MSB (SENT FIRST) | '1'=KEYUP '0'=KEYDOWN | '1'=PASS ON TO NEXT DEVICE |
| BIT 6 - BIT 1 | KEY CODE | COMMAND |
| BIT 0 - LSB | ALWAYS '1' | ALWAYS '0' |

6.2 DATA LINE STATES (REFER TO STATE DIAGRAM, APPENDIX ____)

6.2.1 DATA LINE LOW

1. INDICATES TO KEYBOARD TO SEND 8 LOW-GOING CLOCK PULSES AND READ TOKEN BEING SENT BY HOST.
2. HOST SETS DATA BIT ON FALLING EDGE OF KEYBOARD CLOCK.
3. KEYBOARD READS DATA BIT SLIGHTLY AFTER RISING EDGE OF CLOCK.
4. DATA LINE IS LEFT LOW AFTER TRANSMISSION.

6.2.2 DATA LINE HIGH

1. KEYBOARD SENDS CLOCK PULSES AND DATA TO HOST.
2. KEYBOARD SETS DATA BIT SLIGHTLY BEFORE FALLING EDGE OF CLOCK.
3. HOST READS DATA BIT ON RISING EDGE OF CLOCK.
4. DATA LINE IS LEFT HIGH AFTER TRANSMISSION.

6.3 COMMAND TOKENS

- 6.3.1 NORMAL TOKEN (10H)- THE KEYBOARD WILL SEND A KEY CHANGE IF IT HAS OCCURRED, OTHERWISE, AFTER APPROX. 1/4 SEC TIMEOUT, IT WILL SEND A 'NULL' CODE.
- 6.3.2 INSTANT TOKEN (14H)- KEYBOARD WILL RESPOND IMMEDIATELY WITH A KEY CHANGE IF IT HAD OCCURRED, IF NOT IT WILL SEND A 'NULL' CODE.
- 6.3.3 TEST TOKEN (36H)- THE KEYBOARD WILL PERFORM A SELF-TEST ON ITS INTERNAL RAM AND IF SUCCESSFULL IT WILL RESPOND WITH AN 'ACK' CODE OTHERWISE IT WILL SEND A 'NACK' CODE.
- 6.3.4 MODEL NO TOKEN(16H)-THE KEYBOARD WILL IMMEDIATELY CLEAR RAM AND SEND ITS MODEL NUMBER. THE MODEL NUMBER IS CONFIGURED BY THE FOLLOWING DEFINITIONS:

| | |
|---------|---|
| BIT 0 | ALWAYS SET ('1') |
| BIT 1-3 | KEYBOARD MODEL NUMBER |
| BIT 4-6 | OPTIONAL DAISY-CHAIN DEVICE |
| BIT 7 | SET ('1') IF ANOTHER EXTERNAL DEVICE IS CONNECTED |

7.0 KEY ROLLOVER

7.1 KEYBOARD WILL HAVE TWO-KEY LOCKOUT (IF THERE ARE TWO SIMULTANEOUS VALID KEYDOWNS, SUBSEQUENT KEY DEPRESSIONS WILL BE IGNORED).

8.0 KEY CODES

8.1 ANY KEY DEPRESSION WILL GENERATE A CODE AS INDICATED IN TABLE I. RELEASING A KEY WILL GENERATE THE SAME CODE WITH BIT 7 SET (EX. 'A' KEY: DEPRESS- 001H, RELEASE - 081H).

8.2 CAPS LOCK KEY

8.2.2 THIS KEY IS A MECHANICAL ALTERNATE ACTION SWITCH.

8.2.3 STATE OF KEY WILL NOT BE AFFECTED BY DEPRESSION OF ANY OTHER KEY.

9.0 KEY SWITCH CHARACTERISTICS

9.1 KEY TRAVEL

- 9.1.1 TOTAL TRAVEL SHALL BE 3.5 mm +/- 0.5 mm (0.138 in +/- 0.02 in).
- 9.1.2 PRETRAVEL (DISPLACEMENT FROM FULL UP TO ON POINT) SHALL BE 1.8 mm +/- .25 mm
- 9.1.3 MECHANICAL HYSTERESIS (DISPLACEMENT FROM ON POINT TO OFF POINT) SHALL BE .25 mm +/- .127 mm.

9.2 KEY FORCE

- 9.2.1 KEY FORCE MEASURED AT THE CENTER OF THE KEYPAD SHALL BE 90 gm +/- 25 gm AT THE ON POINT
- 9.2.2 SPACE BAR SHALL HAVE A FORCE OF 90 gm +/- 25gm MEASURED AT BOTH ENDS AT THE ON POINT
- 9.2.3 ALTERNATE ACTION SWITCH (CAPS LOCK) SHALL HAVE A FORCE OF 200 gm +/- 100 gm AT SELF-LOCK POSITION

9.3 KEYBOUNCE

- 9.3.1 TO BE TESTED UNDER NORMAL STRIKING (TYPING) FORCE.
- 9.3.2 KEYBOUNCE SHALL BE 5 ms MAX DURING MAKE /BREAK IN THE REQUIRED CIRCUIT.
- 9.3.3 KEYBOUNCE TIME IS DEFINED AS:
 - SWITCH CLOSURE - VOLTAGE SETTLES TO 10% OF ITS FINAL SHORT CIRCUIT VALUE
 - SWITCH RELEASE - VOLTAGE SETTLES TO 90% OF ITS FINAL OPEN CIRCUIT VALUE

9.4 KEYSWITCH RESISTANCE :

- 9.4.1 CONTACT RESISTANCE- 1 OHM MAX INITIAL
- 9.4.2 INSULATION RESISTANCE - 50 MEGOHMS MINIMUM

9.5 ENVIRONMENTAL REQUIREMENTS

- 9.5.1 SPECIFICATIONS AFTER LIFE AND HUMIDITY TESTS AS SPECIFIED IN APPLE DRAWING 705-0070
 - 9.5.1.1 CONTACT RESISTANCE - 5 OHMS MAX
 - 9.5.1.2 INSULATION RESISTANCE - 10 MEGOHMS MIN
- 9.5.2 AFTER LIFE TEST , ALL SWITCHES SHALL MEET APPLE TEMPERATURE AND HUMIDITY SPEC. *062-0089.

10.0 COIL CORD (REFERENCE DRAWING 590-0144)

10.1 TYPE : 4 CONDUCTOR, 28 AWG (7/36 STRANDED)

10.2 CONNECTORS : TYPE RJ-11 MODJACK (4 PIN) ON EACH END OF CABLE, WITH
NON-REVERSING PINOUT END-TO-END.

10.3 WIRE COLOR CHART FOR BOTH CONNECTORS :

| PIN | COLOR |
|-----|-------|
| 1 | BLK |
| 2 | RED |
| 3 | GRN |
| 4 | YEL |

11.0 KEYCAPS/HOUSING

11.1 KEYBOARD HOUSING

11.12 MUST CONFORM TO APPLE DRAWINGS :

TOP HOUSING 815-0728

BOTTOM HOUSING 815-0754

11.13 MUST MEET REQUIREMENTS OF APPLE SPECS :

COSMETIC AND QUALITY SPEC. 062-2006

062-2004

062-2002

COLOR CONTROL PANEL,APPLE BEIGE 912-0020

11.2 KEYCAPS

11.21 COLOR : APPLE MEDIUM BROWN
PER COLOR CONTROL PANEL 912-0021

11.22 TEXTURE : TOP PER MT1055-2
SIDES PER MT1055-4

11.23 LEGENDS : PER 062-0142 AND INDIVIDUAL PRINTED KEYCAP DWGS
REF. BILL OF MATERIALS

11.24 PULL FORCE : 3 POUNDS MAX WITHOUT DETACHING FROM KEYSWITCH

11.25 LOCATIONS : PER KEYCAP SET DRAWING (SEE APPENDIX)

11.26 QUALITY : MUST CONFORM TO APPLE SPECS :
062-2007 COSMETIC AND QUALITY SPEC
062-0053 KEYCAP COSMETIC SPEC

12.0 MATERIAL REQUIREMENTS

12.1 KEYSWITCH PLATE

12.11 MATERIAL: COLD ROLLED STEEL, C-010 ASTM-A-366

THICKNESS 1.22mm +0.00mm/-0.10mm

12.12 MARKING: MUST BE IDENTIFIED WITH PART NUMBER AND CURRENT REVISION

12.13 MUST BE PER CURRENT ENGINEERING RELEASED DRAWING (REF. BILL OF MATERIALS)

12.2 PRINTED CIRCUIT BOARD

12.21 MATERIAL: CEM-1, SINGLE-SIDED OR EQUIVALENT

1 OZ. COPPER

12.22 MARKING: APPLE LOGO

COPYRIGHT DATE

MANUFACTURER LOGO AND DATE CODE

12.23 FABRICATION: PER APPLE PCB SPEC 062-0031

PER ENGINEERING RELEASED DRAWING

12.3 INTEGRATED CIRCUITS

12.31 MARKING: APPLE PART NUMBER

VENDOR ID*

12.32 LEADS: SOLDERABILITY PER EIA STD. RS-186-9E

12.33 BURN-IN: TEST AND BURN-IN PER APPLE SPEC 062-2009

12.4 DISCRETE COMPONENTS

12.41 SPACING: MUST BE AT LEAST 0.175 IN (4.45mm) FROM OUTER EDGE OF PCB

SPACING BETWEEN COMPONENT CENTERS SHALL BE 0.150 IN (3.81mm).

12.42 LEADS AND EYELETS: SOLDERABILITY PER EIA STD RE-186-9E

12.5 JUMPERS

12.51 MATERIAL: 22 GA.TIN PLATED ANNEALED COPPER PER FEDERAL SPEC QQ-W-343

12.52 SPACING: MUST BE PARALLEL TO EACH OTHER AND IF POSSIBLE, ALIGNED WITH THE "Y"
AXIS.

12.53 LENGTH: 0.5 IN (12.7mm) UNLESS OTHERWISE SPECIFIED

13.0 ENVIRONMENTAL AND RELIABILITY REQUIREMENTS

13.1 EMC (ELECTROMAGNETIC COMPATIBILITY)

EMISSIONS - MUST MEET APPLE CLASS B EMISSION STANDARDS FOR HOME ELECTRONIC DEVICES
WHEN CONNECTED TO A MACINTOSH COMPUTER PER SPEC *062-0088.

SUSCEPTIBILITY - PERFORMANCE DEGRADATION DUE TO EXTERNAL NOISE OR RF WILL BE
CONSIDERED AS SPECIFIED IN *062-088 CLASS B PRODUCTS.

13.2 ESD (ELECTROSTATIC DISCHARGE)

13.21 TESTS TO BE CONDUCTED ACCORDING TO APPLE SPEC *(IN-PROCESS, TO BE DETERMINED).

13.22 ARC DISCHARGES TO KEYBOARD OR MOUNTING PLATE SHALL NOT CAUSE CATASTROPHIC
COMPONENT OR FUNCTIONAL FAILURE.

13.23 FOR VOLTAGE LEVELS UP TO 10KV, STUCK KEYS OR KEYBOARD LOCKUP SHALL NOT OCCUR.

13.24 DISCHARGES TO THE COMPUTER SHALL NOT CAUSE DAMAGE TO THE KEYBOARD.

13.3 SHOCK AND VIBRATION

13.31 THE BARE UNIT (WITHOUT PROTECTIVE PACKAGING) WILL BE TESTED AS DEFINED IN
APPLE SPEC. *062-0086.

13.32 INFORMATION ACCUMULATED FROM THESE TESTS WILL BE CONSIDERED IN THE APPROVAL
PROCESS AND ALSO WILL BE USED TO DESIGN THE FINISHED GOODS PROTECTIVE PACKAGING.

13.33 FOLLOWING AN APPLICATION OF A SHOCK OF 50g's IN ACCORDANCE WITH MIL-STD-202F
METHOD 213B, TEST CONDITION A, THERE WILL BE NO DEFECT IN APPEARANCE OR KEYBOARD
OPERATION.

13.34 FOLLOWING THE VIBRATION TEST, CONDUCTED IN ACCORDANCE WITH MIL-STD-202F METHOD
201A, THERE SHALL BE NO DEFECTS IN APPEARANCE OR KEYBOARD OPERATION.

13.4 TEMPERATURE AND HUMIDITY

13.41 UNIT MUST MEET FUNCTIONAL REQUIREMENTS AFTER TESTING ACCORDING TO APPLE SPEC.
*062-0089 CLASS 1 PRODUCT CLASSIFICATION.

13.5 PRODUCT SAFETY

13.51 UNIT MUST CONFORM TO APPLE SAFETY SPECIFICATION *062-0073.

14.0 PACKAGING

14.1 PACKAGING SHALL BE DESIGNED TO CONFORM TO APPLE PACKAGING FINISHED GOODS SHOCK AND
VIBRATION SPEC. *062-0087.

14.2 KEYBOARD MUST HAVE PROPER ID/SERIAL NUMBER LABELS ATTACHED.

14.3 PACKAGING OF KEYBOARD SHALL BE PER ENGINEERING RELEASED DRAWING
(REF. BILL OF MATERIAL).

15.0 QUALITY ASSURANCE PROVISIONS

15.1 QUALITY ASSURANCE SHALL GUARANTEE THAT THE COMPLETED PRODUCT MEETS THE REQUIREMENTS OF THIS SPECIFICATION.

15.2 THE MACINTOSH KEYBOARD MUST MEET THE STANDARDS OF ALL REFERENCE DOCUMENTS AS LISTED IN PARAGRAPH 4.0 EXCEPT AS NOTED IN PARAGRAPH 2.3.

16.0 APPENDIX

16.1 KEYBOARD KEY CODES

16.2A STATE DIAGRAM

16.2B STATE TIMING DIAGRAM

16.3 TIMING DIAGRAM DETAIL

16.4 KEYCAP LEGEND LAYOUT

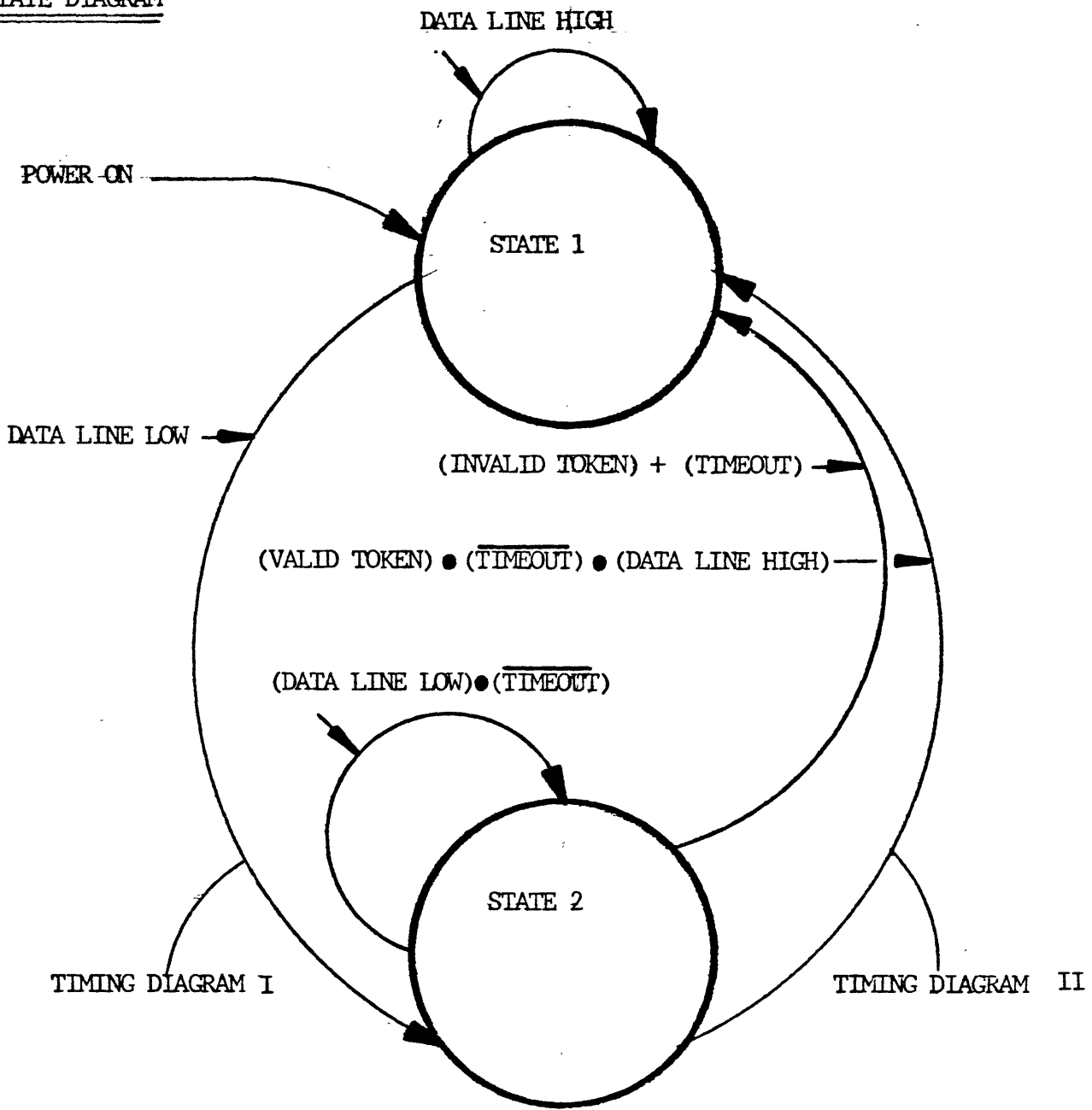
TABLE I

| KEY NO | KEY LEGEND | KEY CODE (HEX) | KEY NO. | KEY LEGEND | KEY CODE (HEX) |
|--------|------------|----------------|---------|------------|----------------|
| 01 | ` | 065H | 30 | A | 001H |
| 02 | 1 | 025H | 31 | S | 003H |
| 03 | 2 | 027H | 32 | D | 005H |
| 04 | 3 | 029H | 33 | F | 007H |
| 05 | 4 | 02BH | 34 | G | 00BH |
| 06 | 5 | 02FH | 35 | H | 009H |
| 07 | 6 | 02DH | 36 | J | 04DH |
| 08 | 7 | 035H | 37 | K | 051H |
| 09 | 8 | 039H | 38 | L | 04BH |
| 10 | 9 | 033H | 39 | ; | 051H |
| 11 | 0 | 03BH | 40 | ' | 04FH |
| 12 | - | 037H | 41 | RET | 049H |
| 13 | = | 031H | 42 | LSHF | 071H |
| 14 | BS | 067H | 43 | Z | 00DH |
| 15 | TAB | 061H | 44 | X | 00FH |
| 16 | Q | 019H | 45 | C | 011H |
| 17 | W | 01BH | 46 | V | 013H |
| 18 | E | 01DH | 47 | B | 017H |
| 19 | R | 01FH | 48 | N | 05BH |
| 20 | T | 023H | 49 | M | 05DH |
| 21 | Y | 021H | 50 | , | 057H |
| 22 | U | 041H | 51 | . | 05FH |
| 23 | I | 045H | 52 | / | 059H |
| 24 | O | 03FH | 53 | RSHF | 071H |
| 25 | P | 047H | 54 | LOPTION | 075H |
| 26 | [| 043H | 55 | COMMAND | 06FH |
| 27 |] | 03DH | 56 | SPACE | 063H |
| 28 | \ | 055H | 57 | ENTER | 069H |
| 29 | CAPS LOCK | 073H | 58 | ROPTION | 075H |

PROTOCOL CODES

| | | |
|---------|------|----------------|
| NACK | 077H | NO-ACKNOWLEDGE |
| KPD ESC | 079H | KEYPAD ESCAPE |
| NULL | 07BH | |
| ACK | 07DH | ACKNOWLEDGE |

STATE DIAGRAM



SIZE
A

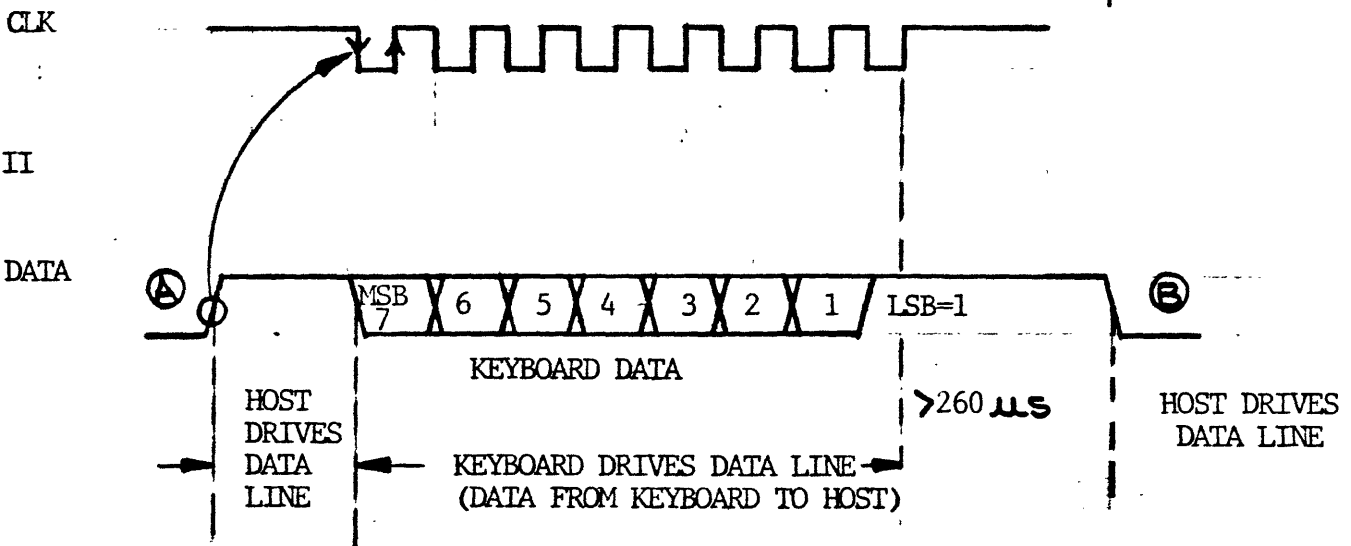
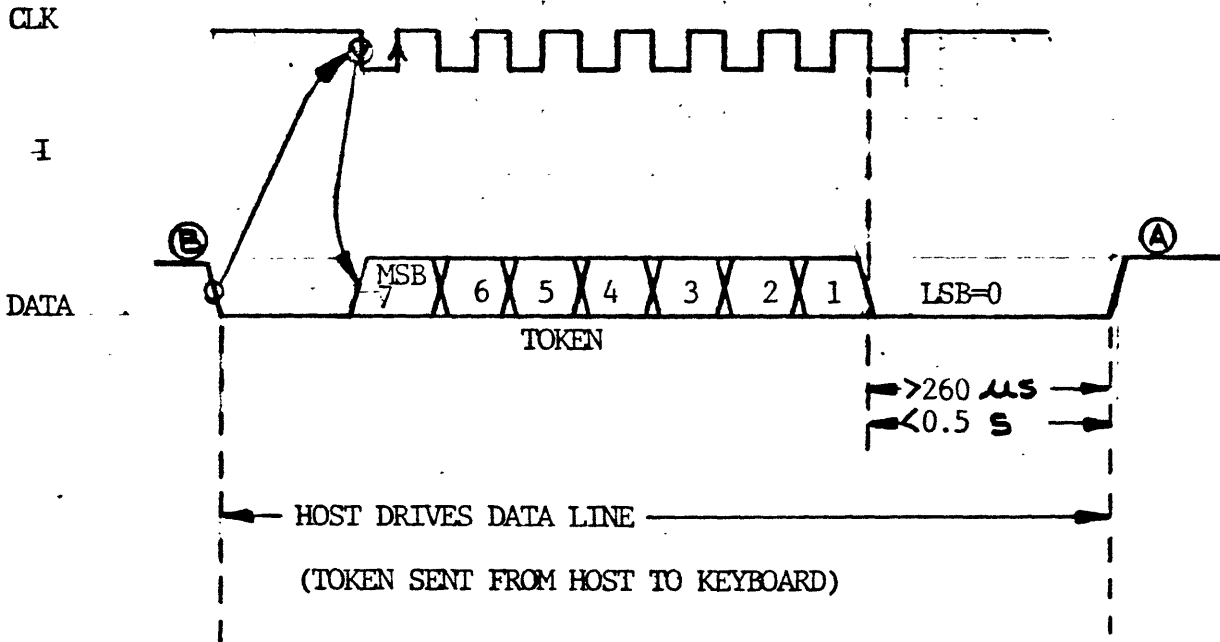
DRAWING NUMBER

SCALE:

SHEET

OF

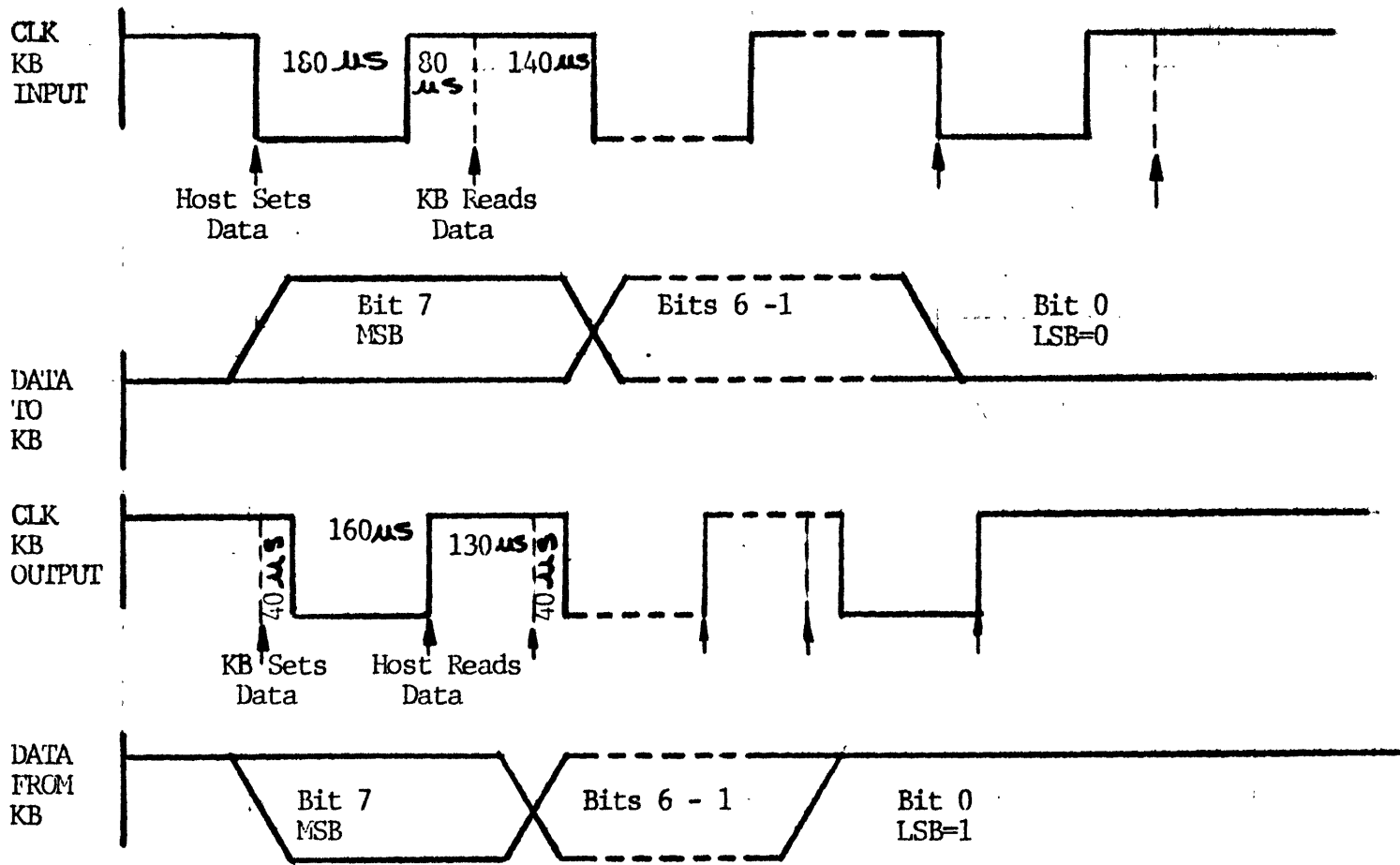
STATE TIMING DIAGRAM



| | | |
|-----------|----------------|----|
| SIZE A | DRAWING NUMBER | |
| SCALE: | SHEET | OF |

Apple Computer Inc.

SCALE: A SIZE DRAWING NUMBER SHEET OF



TIMING DIAGRAM DETAIL

CLOCK TIMING VALUES = $\pm 5\%$

