M68EML08KX

Emulator Module

User’s Manual

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Section 1. General Information

1.1 Introduction

This section provides general information about the Motorola M68EML08KX Emulator Module (KXEM).

The KXEM (Figure 1-1) is a tool designed to emulate or debug existing systems and systems under development that are based on Motorola's MC68HC908KX8 microcontroller (MCU) or MC68HC908KX2 MCU.

To accomplish it's designed task, the module must be mounted onto one of two Motorola development systems (where it can then emulate the desired MCU) and connected to the device under development or evaluation (the target). The target system designer may then use the development system to develop, code, test, and debug functions that are intended for MCUs prior to their coding.

The two development systems are:

- M68HCO508 Motorola Modular Development System (MMDS)
- M68MMEVS Evaluation System (MMEVS).

The MMDS is a development system that provides a bus state analyzer and real-time memory windows. It includes an editor, an assembler, user interface, and source-level debug.

The MMEVS development system is designed for lower functionally than the MMDS and is a lower-cost alternative, two-board tool for designing, debugging, and evaluating MCUs for target systems.

NOTE: *For a complete description of either system, refer to their operation manuals, MMDS0508OM/D or MMEVS0508OM/D. For a description of the software used with the development systems, refer to Rapid Integrated Development Environment User's Manual, Rapid/D.*

When the KXEM is installed in a selected development system, it becomes a part of the system dependent for it's power (1.9 to 5.2 Vdc or 1.2 to 3.2 Vdc) and interface connections on the development system.

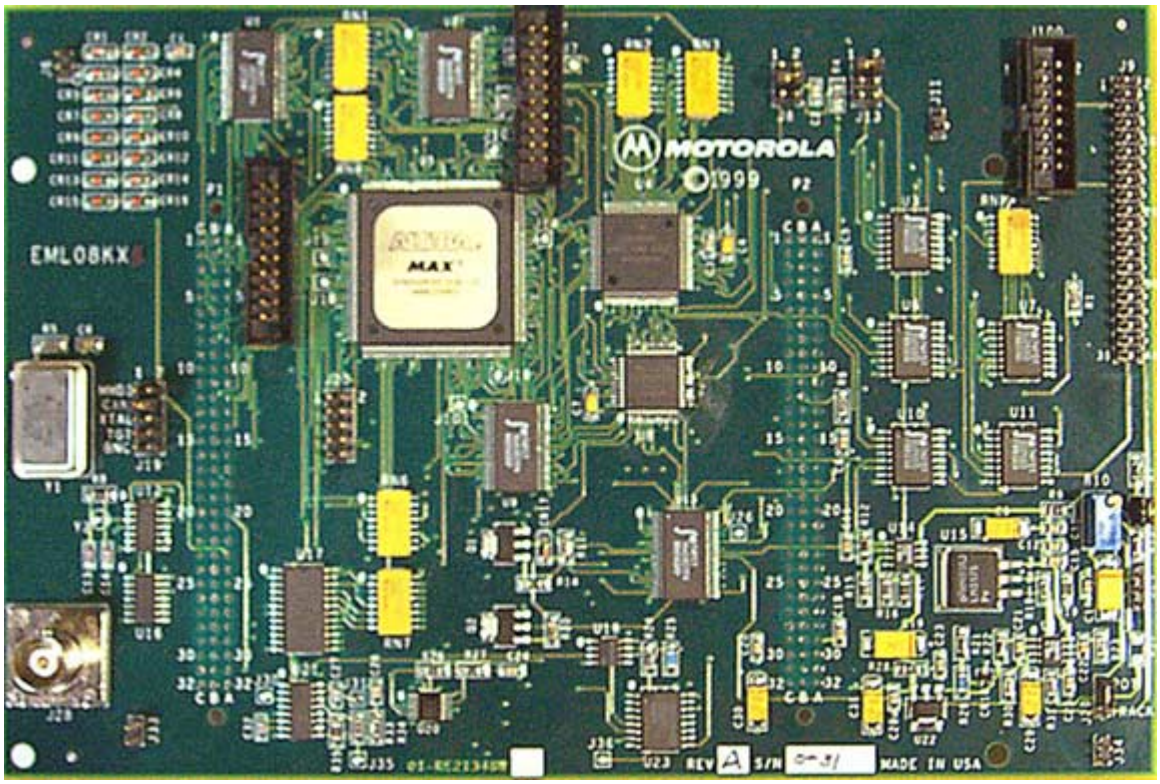


Figure 1-1 Motorola M68EML08KX Emulator Module (KXEM)

1.2 KXEM Components

The complete KXEM system includes hardware, software, and documentation. lists the KXEM product components.

Table 1-1. KXEM Hardware Components

Part Number	Description
EMLO8KX	Board assembly

1.2.1 KXEM Hardware

lists the KXEM hardware components.

Table 1-2. Hardware Connector Components

Components	Description
J9	2-row × 20-pin, 0.1-inch spacing connector to connect the KXEM to a target using the M68CLB05A flex cable.
P1	3-row x 32-pin connector to connect the KXEM to the Control Board or Platform Board in an evaluation system.
P2	3-row x 32-pin connector to connect the KXEM to the Control Board or Platform Board in an evaluation system.
J1, J12	Logic analyzer ports.
J28	BMC connector that allows an external timing signal to be used.

1.2.2 Interface Software

Table 1-3 shows the disk that contains the personality files that must be installed for use with the KXEM.

Table 1-3. Software Components

Part Number	Description
87-RE10039W01 Personality Files and User Manual	Personality Files Disk

1.3 Specifications

Table 1-4 summarizes the KXEM hardware specifications.

Table 1-4. KXEM Evaluation Module Specifications

Characteristic	Specification
Temperature: Operating Storage	 0° to 40°C –40° to +85°C
Relative humidity	0 to 90%, non-condensing

Table 1-4. KXEM Evaluation Module Specifications

Characteristic	Specification
Power requirement	+5 Vdc, provided from the MMDS control board or the MMEVS platform board
MCU extension I/O ports	HCMOS compatible
Dimensions	8.15" x 4.5" (207 x 115 mm)
Weight	7.1 ounces (201 gm)

1.4 About This Manual

This manual describes the KXEM Emulator Module. For operational procedures when using this board, refer to the development system's operations manual.

1.5 Customer Support

To obtain information about technical support or ordering parts, call the Motorola help desk at 800-521-6274. For a list of Motorola sales offices and distributors: http://www.mcu.motsps.com/sale/off.html

Section 2. Preparation and Installation

2.1 Introduction

This section provides information and instruction for configuring and installing the M68EML08KX Emulator Module (KXEM) for use.

2.2 Hardware Preparation

ESD CAUTION: *Ordinary amounts of static electricity from clothing or the work environment can damage or degrade electronic devices and equipment. For example, the electronic components installed on the printed circuit board are extremely sensitive to electrostatic discharge (ESD). Wear a grounding wrist strap whenever handling any printed circuit board. This strap provides a conductive path for safely discharging static electricity to ground.*

2.2.1 KXEM Considerations and Limitations

The KXEM module uses an MC68HC908GP32 MCU to emulate the functions of the MC68HC908KX8 MCU and MC68HC908KX2 MCU. These sub-paragraphs describes the limitations caused by the configuration.

NOTE: *The schematics in Section 3 are marked as M68EM908KX6. The logic for the M68EML908KX (KXEM) is the same as the M68EM908KX6, however the GP20 MCU, of the M68EM908KX6, has been replaced with an enhanced GP32 processor. The schematics may be used with the KXEM.*

2.2.1.1 Registers

All five registers in the internal clock generator (ICG) module and the control register (TBCR) of the time base module (TBM) are rebuilt externally. The ICG register addresses of the MC68HC908KX8 and MC68HC908KX2 are the same addresses as the phase lock loop (PLL) register in the MC68HC908GP32. The

ICG register addresses and TBCR address must be moved to the RAM in order to correctly emulate these functions (Table 2-1). This takes a total of 6 bytes of the user RAM addresses. Code must be started at $46 instead of $40 in the RAM for emulating purposes.

Table 2-1 Register KXEM Address Configuration

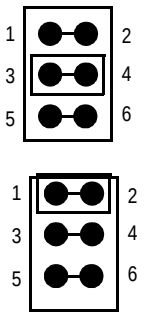
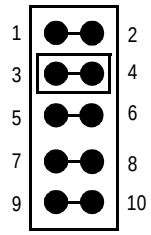
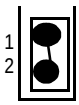
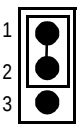
Register Name	Original Register Address (MC68HC908KX)	New Register Address in the RAM (KXEM)
ICGCR	$0036	$0040
ICGMR	$0037	$0041
ICGTR	$0038	$0042
ICDVR	$0039	$0043
ICGDSR	$003A	$0044
TBCR	$001C	$0045

2.2.2 Configuring the KXEM Jumper Headers

The KXEM has five (5) jumper headers that you may configure for specific requirements (Table 2-2).

CAUTION: *The KXEM can be set to operate at a variety of voltages. When configuring the KXEM jumper headers, care must be exercised to ensure that the voltages selected for the board match those of the target device. Failure to do so can result in damage to either or both of the pieces of equipment.*

Table 2-2 KXEM Jumper Header Description

Jumper Header	Type (Factory Default Shown	Description
J8 and J13 V_{REFH} bonding option		Jumper between pins 3 and 4 on jumper header J8 and jumper between pins 1 and 2 on jumper header J13 (factory default): emulates an MC68HC908KX with pin 15 configured as PTA4/KBD4, a standard port pin. Jumper between pins 5 and 6 on jumper header J8 and jumper between pins 3 and 4 on jumper header J13: emulates MC68HC908KX with pin 15 configured as V_{REFH} for A/D converters. *Note: Do not jumper to any other configuration.*
J19 MCU clock source select		Jumper between pins 1 and 2: selects the MMDS control board or MMEVS platform board as the signal source Jumper between pins 3 and 4 (factory default): selects the 8.000-MHz oscillator at location Y1 as the signal source Jumper between pins 5 and 6: selects a user-supplied crystal as the signal source; requires user to install a crystal at Y1, resistors at R8 and R52, and capacitors at C13 and C14 (See schematics in Section 3.) Jumper between pins 7 and 8: selects the timing in the user target system as the signal source Jumper between pins 9 and 10; selects the BNC connector (J28) as the signal source
J25 MCU voltage range select		Jumper between pins 1 and 2 (factory default): selects the range of R10 to be 1.2 V – 3.25 V No jumper: selects the range of R10 to be 1.9 V – 5.25 V
J29 MCU voltage reference select		Jumper between pins 1 and 2 (factory default): selects the MCU voltage to be controlled by R10 Jumper between pins 2 and 3: selects the MCU voltage to track the user's target system
J3, J4, J6, J11, J17, J20, J24, J33, J34		Factory programming, testing, and development purposes. Leave OPEN, i.e., no jumper.

2.3 Adjusting MCU Voltage (VMCU)

To allow for differences in target board voltages, Test Point J27 and variable resistor R10 allow the adjustment of the MCU voltage (VMCU) within a range set by the MCU voltage Range Jumper Header (J25) (Table 2-2).

To adjust the MCU voltage (VMCU):

1. Make sure that no target cable is connected to connector J9.
2. Connect a voltmeter across J27 pins 1 (VMCU) and 2 (GND).
3. Turn the resistor, R10, adjustment screw until the voltmeter reads the appropriate level for the target board in use.
4. Disconnect the voltmeter.

CAUTION: *Make sure that the target system's operating voltage matches the MCU voltage level before connecting the target cable to connector J9.*

2.4 Connecting the KXEM

The following steps provide instructions for connecting the KXEM to the target device.

ESD CAUTION: *Ordinary amounts of static electricity from clothing or the work environment can damage or degrade electronic devices and equipment. For example, the electronic components installed on the printed circuit board are extremely sensitive to electrostatic discharge (ESD). Wear a grounding wrist strap whenever handling any printed circuit board. This strap provides a conductive path for safely discharging static electricity to ground.*

2.4.1 Connecting KXEM to MMDS and Target Device

a. Remove the top half of the MMDS.

b. Align the KXEM module with the control board of the MMDS so that connectors P1 and P2 (on the bottom of the KXEM) are matched to P1 and P2 on the control board.

c. Press P1 and P2 of the KXEM into P1 and P2 of the control board.

d. Snap the corners of the KXEM onto the plastic standoffs of the MMDS.

e. Connect one end of the Target Flex Cable to J9 on the KXEM.

f. Connect the other end of the Target Flex Cable to the appropriate connector on the target device.

g. Connect the MMDS, according to the instructions in it’s operating manual.

h. Copy the Personality Files from the disk provided to the directory that contains your debugging software. The files are:

- Em08kx8.mem Personality file for 68HC908KX8
- Em08kx8.reg Register file for 68HC908KX8
- Em08kx2.mem Personality file for 68HC908KX2
- Em08kx2.reg Register file for 68HC908KX2

NOTE: *If you are using the MCUEZ software, you will need to rename the appropriate personality and register files before executing the MCUEZ Debugger for the first time. Rename the appropriate personality file (*.mem) to "00C2BV03.MEM." Rename the appropriate register file (*.reg) to "MCUIOC2B.REG." For example, if you are going to emulate a KX8 MCU, rename "em08kx8.mem" to "00c2bv03.mem", and rename "em08kx8.reg" to "mcuioc2b.reg."*

If you are using P & E Software’s MMDS or MMEVS software, you will need to rename the appropriate personality file before executing the emulation software for the first time. The emulation software will look for the 0042BV??.MEM file in the directory containing the emulation software. Rename the appropriate personality file to "0042BV03.MEM." Note that the "V03" on the filename represents the version and may change, such as to "V04" or "V05." the software will look for the most up-to-date revision, by looking for "V06" first and progressing downwards to "V00." The "0042B" is an ID read from the emulator top board and is used to decide which personality file to load. The register files are not used by the P & E software. The P & E software has it’s own files which are included with the installation of the software.

2.4.2 Connecting KXEM to MMEVS and Target Device

a. Remove the top half of the MMDS.

b. Align the KXEM module with the platform board of the MMEVS so that connectors P1 and P2 (on the bottom of the KXEM) are matched to P1 and P2 on the platform board.

c. Press P1 and P2 of the KXEM into P1 and P2 of the platform board.

d. Snap the corners of the KXEM onto the plastic standoffs of the MMEVS.

e. Connect one end of the Target Flex Cable to J9 on the KXEM.

f. Connect the other end of the Target Flex Cable to the appropriate connector on the target device.

g. Connect the MMEVS, according to the instructions in it's operating manual.

h. Copy the Personality Files from the disk provided to the directory that contains your debugging software. The files are:

- Em08kx8.mem Personality file for 68HC908KX8
- Em08kx8.reg Register file for 68HC908KX8
- Em08kx2.mem Personality file for 68HC908KX2
- Em08kx2.reg Register file for 68HC908KX2

NOTE: *If you are using the MCUEZ software, you will need to rename the appropriate personality and register files before executing the MCUEZ Debugger for the first time. Rename the appropriate personality file (*.mem) to "00C2BV03.MEM." Rename the appropriate register file (*.reg) to "MCUIOC2B.REG." For example, if you are going to emulate a KX8 MCU, rename "em08kx8.mem" to "00c2bv03.mem", and rename "em08kx8.reg" to "mcuioc2b.reg."*

If you are using P & E Software's MMDS or MMEVS software, you will need to rename the appropriate personality file before executing the emulation software for the first time. The emulation software will look for the 0042BV??.MEM file in the directory containing the emulation software. Rename the appropriate personality file to "0042BV03.MEM." Note that the "V03" on the filename represents the version and may change, such as to "V04"

or "V05." the software will look for the most up-to-date revision, by looking for "V06" first and progressing downwards to "V00." The "0042B" is an ID read from the emulator top board and is used to decide which personality file to load. The register files are not used by the P & E software. The P & E software has it’s own files which are included with the installation of the software.

Section 3. Support Information

3.1 Introduction

This section includes data and information that may be useful in the design, installation, and operation of your application.\

3.2 KXICS Connector Signal Definitions

The tables in this section describe the pin assignments for the connectors on the KXICS board.

3.2.1 Target Cable Interface Connector J9

The KXEM includes a connector, J9 (Figure 3-1) (Table 3-1), which allows a convenient connection to the target, using a 40-pin ribbon cable.

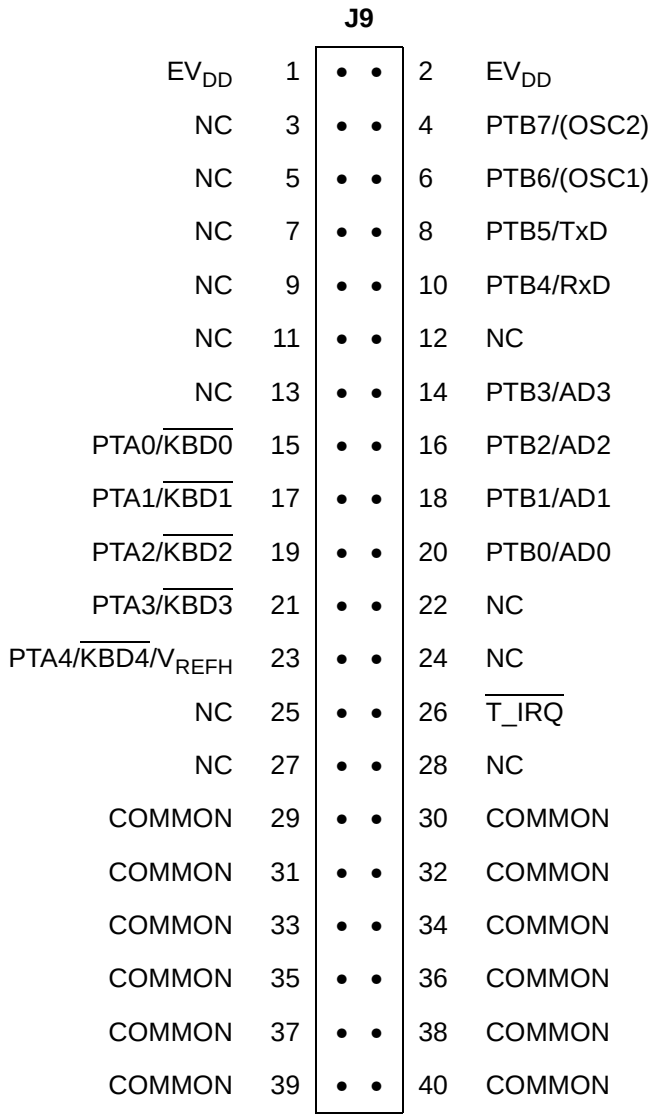


Figure 3-1 Target Connector J9 Pin Assignments

Table 3-1 Target Connector J9 Pin Descriptions

Pin No.	Schematic NET	Direction	Signal Description
1	EV_{DD}		Operating voltage of target device
2	EV_{DD}		Operating voltage of target device
3	NC		
4	PTB7/OSC2	Bidirectional	General Purpose I/O - Clock from target
5	NC		
6	PTB6/OSC1	Bidirectional	General Purpose I/O - Clock to target
7	NC		
8	PTB5/TxD	Bidirectional	General Purpose I/O
9	NC		
10	PTB4/RxD	Bidirectional	General Purpose I/O
11	NC		
12	NC		
13	NC		
14	PTB3/AD3	Bidirectional	General Purpose I/O
15	PTA0/$\overline{KBD0}$	Bidirectional	General Purpose I/O
16	PTB2/AD2	Bidirectional	General Purpose I/O
17	PTA1/$\overline{KBD1}$	Bidirectional	General Purpose I/O
18	PTB1/AD1	Bidirectional	General Purpose I/O
19	PTA2/$\overline{KBD2}$	Bidirectional	General Purpose I/O
20	PTB0/AD0	Bidirectional	General Purpose I/O
21	PTA3/$\overline{KBD3}$	Bidirectional	General Purpose I/O
22	NC		
23	PTA4/$\overline{KBD4}$/ V_{REFH}	Bidirectional	General Purpose I/O - ADC reference from target
24	NC		
25	NC		
26	$\overline{T\_IRQ}$		Interrupt request from target
27	NC		

Pin No.	Schematic NET	Direction	Signal Description
28	NC		
29	COMMON		EM ground
30	COMMON		EM ground
31	COMMON		EM ground
32	COMMON		EM ground
33	COMMON		EM ground
34	COMMON		EM ground
35	COMMON		EM ground
36	COMMON		EM ground
37	COMMON		EM ground
38	COMMON		EM ground
39	COMMON		EM ground
40	COMMON		EM ground

3.2.2 Logic Analyzer Connectors J1 and J12

The KXEM has two logic analyzer connectors, J1 and J12. Each is a 20-pin connector. Figure 3-2 shows the pin assignments for these connectors. Table 3-1 and Table 3-3 give the signal descriptions.

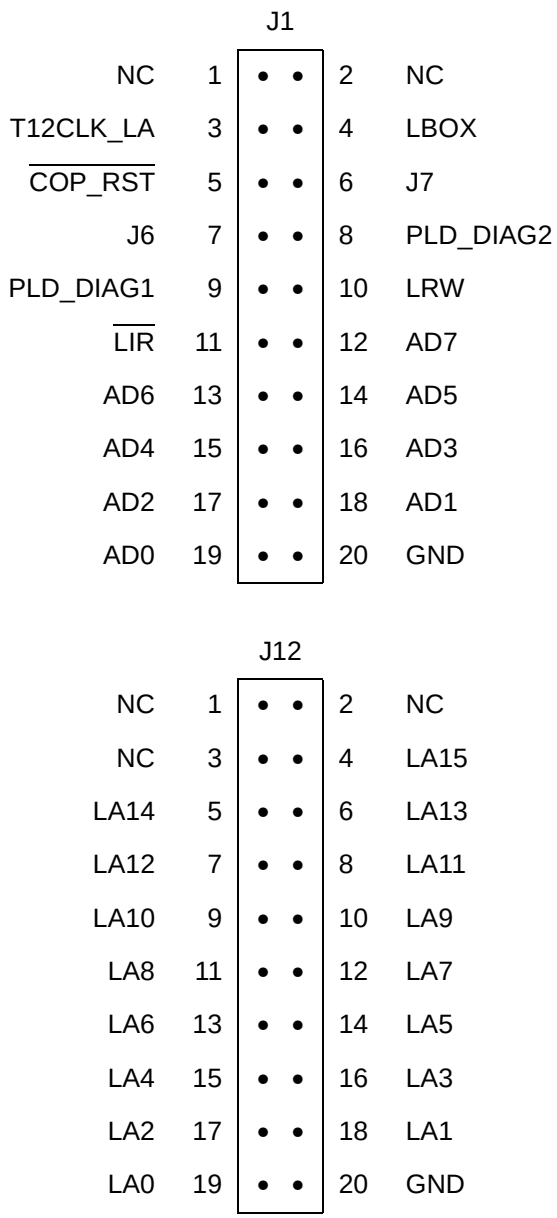


Figure 3-2 Logic Analyzer Connectors J1 and J12 Pin Assignments

Table 3-2 Logic Analyzer Connector J1 Signal Descriptions

Pin No.	Mnemonic	Signal
1, 2	NC	No connection
3	T12_CLK	T12 CLOCK — Clock signal from the MCU internal bus clock
4	LBOX	LAST BUS CYCLE — Signal that indicates the last cycle of the current instruction
5	$\overline{\text{COP\_RST}}$	RESET — Active-low signal asserted during resets
6	NC	No connection
7	NC	No connection
8	NC	No connection
9	NC	No connection
10	LRW	READ/WRITE — Signal indicating whether the MCU is reading or writing
11	$\overline{\text{LIR}}$	LOAD INSTRUCTION REGISTER — Active-low signal indicating that an opcode fetch is in progress
12 – 19	D7 – D0	DATA (bits 7 – 0) — MCU data signal
20	GND	GROUND

Table 3-3 Logic Analyzer Connector J12 Signal Descriptions

Pin No.	Mnemonic	Signal
1 – 3	NC	No connection
4 – 19	LA15 – LA0	ADDRESS BUS (bits 15 – 0) — MCU latched address
20	GND	GROUNDKX6

3.3 Target Cable Assembly

To connect the KXEM to a target system, a separately purchased target cable assembly is needed, as well as the appropriate target head and target-head/adapter package. Figure 3-3 shows how one end of the flex cable plugs into the KXEM module and how the target head connects into the target system.

When installing the KXEM in the MMDS station module, run the flex cable through the slit in the station-module enclosure.

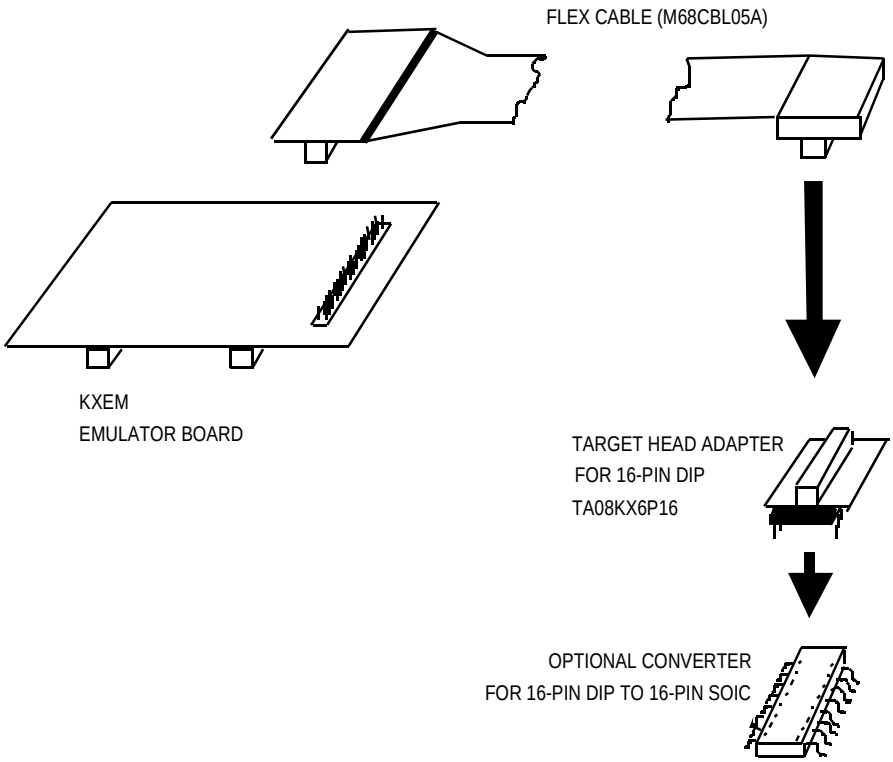


Figure 3-3 Target Cable Assembly

3.4 KXEM Parts List

Table 3-4. KXEM Parts List REV C

Reference Designator	Description	Manufacturer	Part Number
	PRINTED WIRING BOARD - EML08KX	KOREA CIRCUITS OF AMERICA	84-RE21348201 REV A
	PWB ASSEMBLY DRAWING - EML08KX6	MOTOROLA	01DSE21348W REV A
	TEST PROCEDURE - ELM08KX	MOTOROLA	12ASE10038W REV O
	TEST FIXTURE FOR EML08KX6	MOTOROLA	01-RE10003W01 REV A
CR1-CR7	DIODE, SCHOTTKY BARRIER SWITCHING, SMT	VISHAY	ZR431F01
CR18	DIODE, ADJ. SHUNT REGULATOR, SMT	ZETEX	ZR431F01
C1-C3, C5-C8, C10-C12,C15, C16, C18, C20-C26, C28, C33-C48, C50-C90, C94	CAP, 0.1UF, 805	PANASONIC	ECWU1H104JB9
C4, C47, C49, C92	CAP, 1UF, 16V, TANTALUM, CASE A	SPRAGUE	293D105X0016A2T
C9, C29-C31	CAP, 10UF, 16V, TANTALUM, CASE C	SPRAGUE	193D106X0016C2T
C13, C14	CAP, 22PF CERAMIC CHIP 805	KEMET	C0805C220M5GAC
C17, 19	CAP, 47UF, 16V, TANTALUM SMDD	SPRAGUE	293D476X0016D2T
C27	CAP, 4.0PF CERAMIC CHIP 805	PANSONIC	ECU-V1H040CCN
C32	CAP, 220PF CERAMIC CHIP 1% 805	PANSONIC	ECU-V1H221JCG
C91	CAP, 100PF CERAMIC CHIP 805	PANASONIC	ECU-V1H101JCG
C93	CAP, 0.22UF CERAMIC CHIP 805	PANASONIC	ECJ-2VB1C224K
J1,J4	CONN, .100 IN PITCH 2X10 4 WALL HDR	3M	2520-6002UB
J5, J7,J10, J14-J16, J18, J26, J30, J31, J35, J36, J101	HDR, .100 IN. PITCH 1X1	BERG	69190-601

Table 3-4. KXEM Parts List REV C

Reference Designator	Description	Manufacturer	Part Number
J6, J11, J25, J33, J34	HDR, .100 IN PITCH 2X1	BERG	69190-602
J8, J13	HDR, .100 IN PITCH 2X3	DUPONT	69192-606
J9	HDR, .100 IN PITCH 2X20	DUPONT	69192-640
J19, J20	HDR, .100 IN PITCH 2X5	DUPONT	69192-610
J27, J29	HDR, .100 IN PITCH 3X1	BERG	69190-603
J28	CONN, BNC FEMAL, PCB MOUNT	AMP	227699-1
J100	HDR, .100 IN PITCH 2X8	BERG	69190-616
l1-l5	FERRITE BEAD	MURATA	BLM-31A700S
P1, P2	CONN, DIN 96 PIN FEMALE	PANDUIT	100-096-453
Q1, Q2	DMOS FET, N CHANEL	ZETEX	ZVNL110G
RN1	RES, 22 OHMS NETWORK	BOURNS	4816P-001-220
RN2, RN3	RES, 4.7K OHMS NETWORK	BOURNS	4816P-001472
RN4, RN6, RN7	RES, 10K OHMS NETWORK	BOURNS	4816P-001-103
RN5	RES, 33K OHMS NETWORK	BOURNS	4816P-001-333
R1, R2, R4-R6, R11, R18, R23, R30, R31, R38-R42, R45-R49, R53, R55	RES, 10K OHMS, 5%, 1/8W	KOA	RM73B2B103J
R7	RES, 1.5K OHMS, 1%, 1/8W	KOA	RK73H2B1501F
R8	RES, 20M OHMS, 5%, 1/8W	KOA	RK732B206J
R9	RES, 2K OHMS, 1%, 1/8W	KOA	RK732B2001F
R10	RES, 1K OHMS VARIABLE POT	BOURNS	3296W-1-102
R12	RES, 38.3K OHMS, 1%, 1/8W, 1206	KOA	RK732B3832F
R13	RES, 562K OHMS, 1%, 1/8W, 1206	KOA	RK73H2B5620F
R14, R20, R26, R43, R44, R51, R54	RES, 27K OHMS, 5%, 1/8W, 1206	KOA	RK73B2B270J
R15	RES, 49.9K OHMS, 1%, 1/8W, 1206	KOA	RK73H2B4992F

Table 3-4. KXEM Parts List REV C

Reference Designator	Description	Manufacturer	Part Number
R16	RES, 22.1K OHMS, 1%, 1/8W, 1206	KOA	RK73H2B2212F
R17	RES, 15K OHMS, 1%, 1/8W, 1206	KOA	RK73H2B1502F
R19, R28	RES, 510K OHMS, 5%, 1/8W, 1206	KOA	RK73B2B511J
R21	RES, 10K OHMS, 1%, 1/8W, 1206	KOA	RK73H2B1002F
R22	RES, 1K OHMS, 5%, 1/8W, 1206	KOA	RK73B2B10J
R24	RES, 2.21K OHMS, 1%, 1/8W, 1206	KOA	RK73H2B2211F
R25, R29	RES, 1K OHMS, 1%, 1/8W, 1206	KOA	RK73H2B1001F
R26	RES, 750K OHMS, 1%, 1/8W, 1206	KOA	RK73H2B7500F
R27, R34	RES, 270K OHMS, 5%, 1/8W, 1206	KOA	RK73B2B271J
R33	RES, 750K OHMS, 5%, 1/8W, 1206	KOA	RK73B2B750J
R35, R56	RES, 3.32K OHMS, 1%, 1/8W, 1206	KOA	RK73H2B3321F
R52	RES, 510K OHMS, 5%, 1/8W, 1206	KOA	RK73B2B514J
R57	RES, 100K OHMS, 5%, 1/8W, 1206	KOA	RK73B2B104J
U1	IC, 16 BIT LATCH, SMT	IDT	74FCT162373CTPV
U2, U9, U13	IC, 16 BIT VOLTAGE TRANSLATING BUFFER, SMT	PHILLIPS	74ALVC164245DL
U2, U9, U13 (ALT.)	IC, 16 BIT VOLTAGE TRANSLATING BUFFER, SMT	TI	SN74ALVC164245DL
U3, U6, U7, U10, U11	IC, 4 BIT BUS SWITCH, SMT	IDT	74FST3125SO
U4	IC, 10 BIT PORT REPLACEMENT UNIT	MOTOROLA	MC68HC08AD10PRUFN 68
U5	IC, PLD	ALTERA	EPM9480RC208-15

Table 3-4. KXEM Parts List REV C

Reference Designator	Description	Manufacturer	Part Number
U8	IC, 68HC908GP32, 44 PIN QFP MCU, SMT	MOTOROLA	MC68HC908GP32CFB
U12	IC, HEX UNBUFFERED INVERTER, SMT	MOTOROLA	MC74HCU04AD
U14, U19	IC, DUAL PRECISION OP AMP, SMT	MAXIM	MCX478CSA
U15	IC, LNEAR VOLTAGE REGULATOR, SMT	NATIONAL	LM317S
U16	IC, HEX SCHMITT TRIGGER, SMT	MOTOROLA	MC74AC14D
U17	IC, PROGRAMMABLE DIVIDE BY N COUNTER, SMT	PHILIPS	74HC4059D
U18	IC, HIGH SPEED, MICROPOWER TIMER, SMT	ALD	ALD1502SA
U20	IC, PHASE LOCK LOOP, SMT	TI	TLC2932IPWLE
U21	IC, PHASE LOCK LOOP, DETECTOR, SMT	PHILIPS	74HC7046D
U22	IC, LOW DROPOUT, POS REG., SMT	BURR BROWN	REG1117
U23	IC, DUAL DIGITAL POT, SMT	DALLAS	DS1267S10
Y1 (INSTALLED ON XY1)	OSCILLATOR, CAN 8MHZ	EPSON or FOX	SG-531P-8.000MC or F1100E-8MHZ
Y2	QUARTZ RESONATOR, 32.768	EPSON	C-001R32768
J8, J13, J19, J25, J29	SHUNT, 2 POSITION .100	KRISTA MICRO	24-872
XY1	SKT, 14 PIN DIP, .300 SPACING, THRUHOLE	ROB NUGENT or AMP	ICE-143-S-TG30 or 544184-4

3.5 KXEM Board Layout and Schematic Diagrams

NOTE: *The schematics in Section 3 are marked as M68EM908KX6. The logic for the M68EML908KX (KXEM) is the same as the M68EM908KX6, however the GP20 MCU, of the M68EM908KX6, has been replaced with an enhanced GP32 processor. The schematics may be used with the KXEM.*

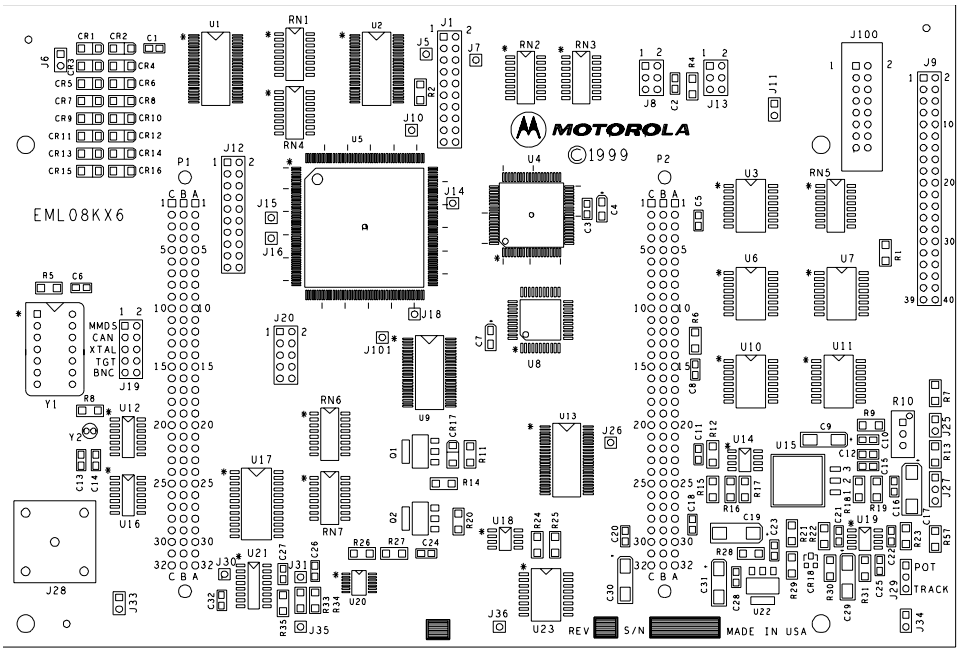


Figure 3-4 KXEM Module Layout

TABLE OF CONTENTS

1	COVER
2	TOP LEVEL OF HIERARCHY
3	PORT LOGIC (PLD)
4	MCU
5	VOLTAGE REGULATORS AND CLOCK GENERATION
6	BYPASS/DECOUPLING CAPACITORS AND SPARES

KX6

KX6

REVISIONS

REV	DESCRIPTION	DATE	REVISED BY
O	ORIGINAL RELEASE	2/24/99	JEK
A	PRODUCTION RELEASE	4/16/99	JEK

GENERAL NOTES:

1. INTERPRET DIAGRAM IN ACCORDANCE WITH AMERICAN NATIONAL STANDARDS INSTITUTE SPECIFICATIONS, CURRENT REVISION, WITH THE EXCEPTIONS OF LOGIC BLOCK SYMBOLOGY.

2. DEVICE TYPE NUMBER IS FOR REFERENCE ONLY. THE NUMBER VARIES WITH THE MANUFACTURER.

3. SPECIAL SYMBOL USAGE:

   * DENOTES ACTIVE LOW SIGNAL
   « » DENOTES OFFPAGE CONNECTOR

4. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS, 5%, 1/8 WATT
   ALL CAPACITORS ARE IN uF, +/-20%, 50V
   ALL VOLTAGES ARE DC
   ALL POLARIZED CAPACITORS ARE TANTALUM

DRAWN:	John E. Keenan	DATE:	4/16/99
CHECKED:		DATE:	
APPROVED:		DATE:	

MOTOROLA
SEMICONDUCTOR PRODUCTS SECTOR
6501 WILLIAM CANNON DRIVE WEST AUSTIN, TX 78735 USA

Title: M68EM908KX6 SCHEMATIC

Size	Dwg. No.	Rev:
C	63CSE21348W	A

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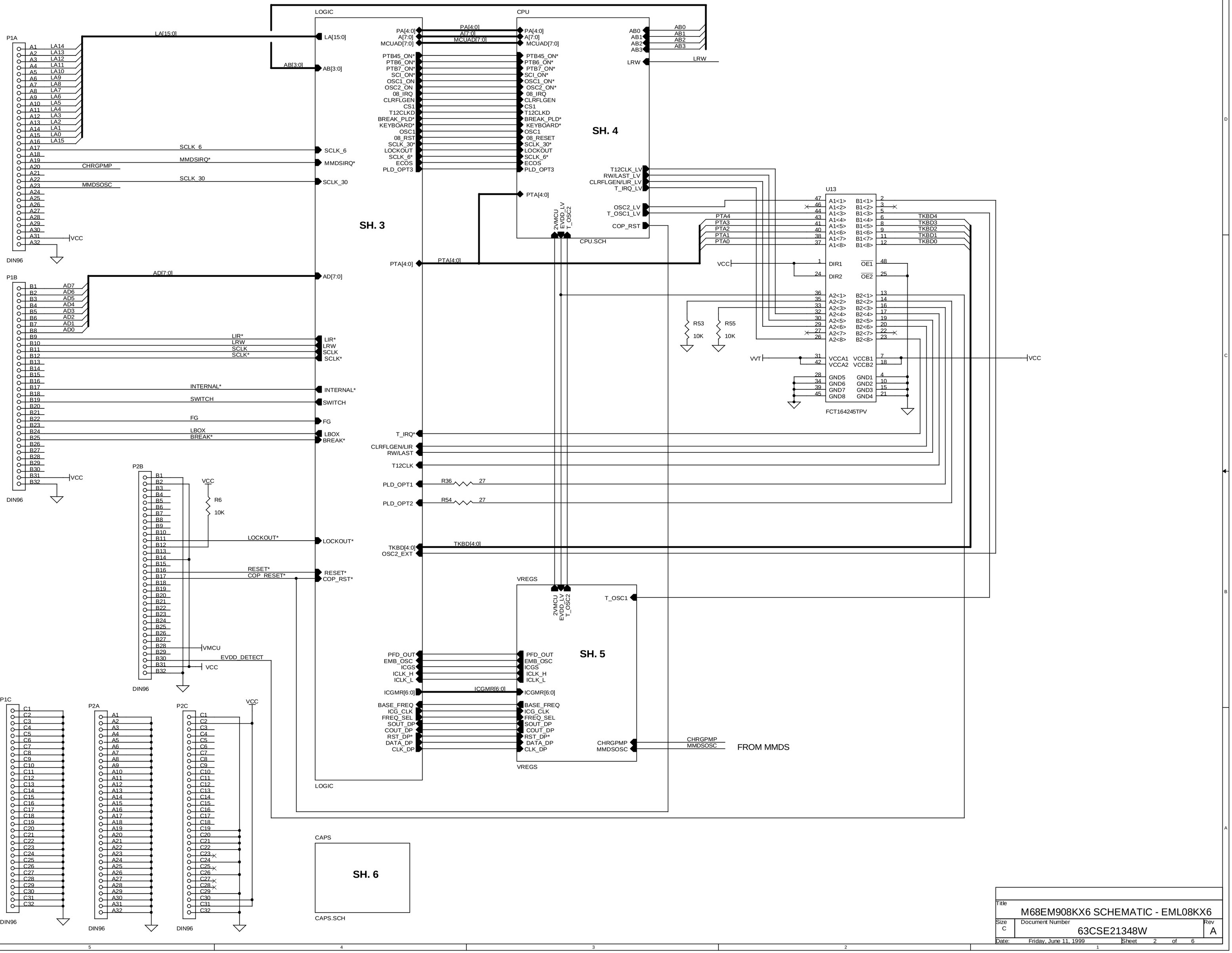

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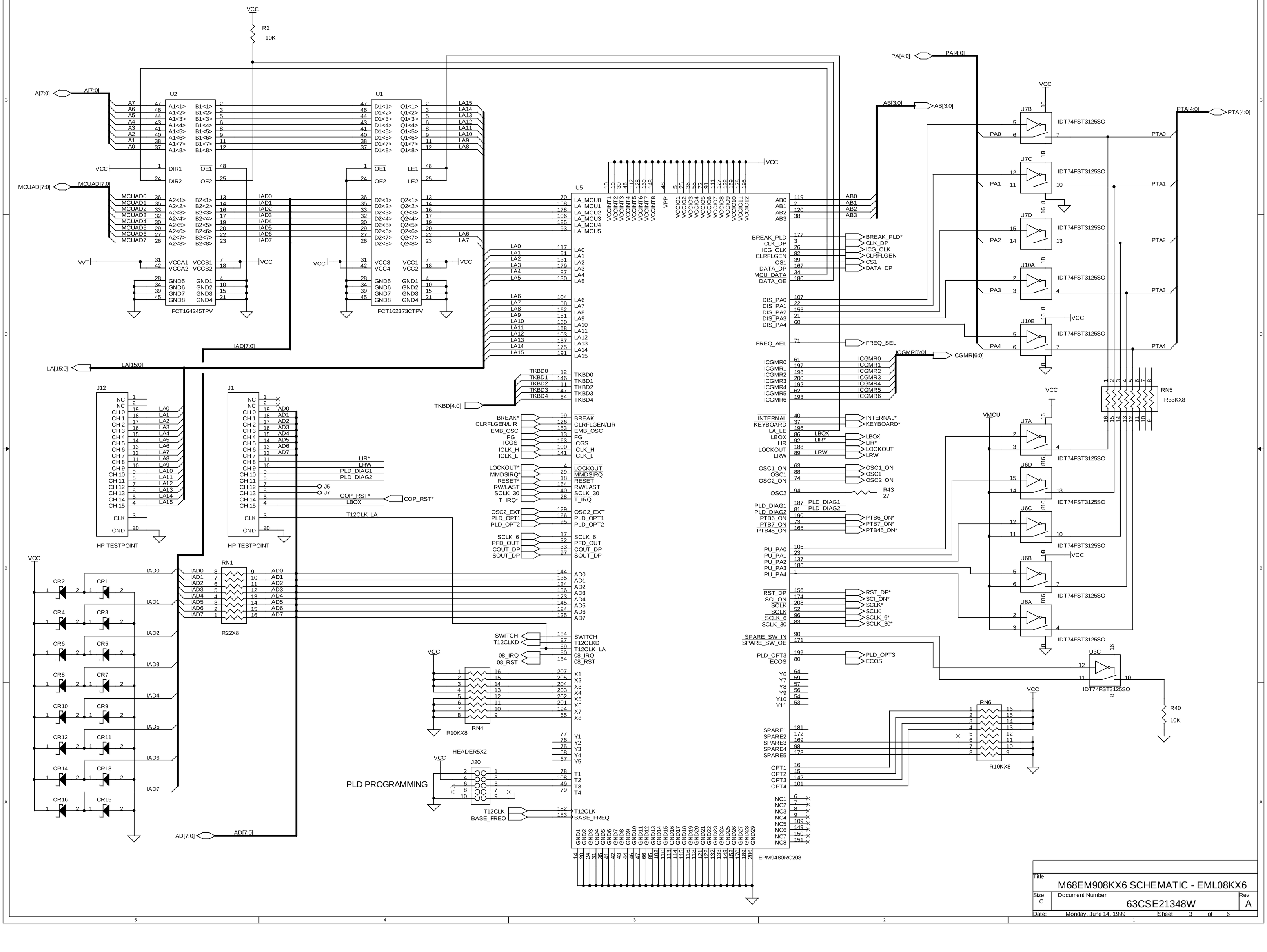
VCC
R2
10K
A[7:0]
U2
U1
FCT164245TPVFCT162373CTPV
MCUAD[7:0]
IAD[7:0]
LA[15:0]
U5
EPM9480RC208
PA[4:0]
AB[3:0]
ICGMR[6:0]
FREQ_SEL
U7B
U7C
U7D
U10A
U10B
U7A
U6D
U6C
U6B
U6A
U3C
IDT74FST3125SO
PTA[4:0]
VMCU
RN5
R33KX8
RN6
R10KX8
R40
10K
R43
27
J12
J1
HP TESTPOINT
RN1
R22X8
CR1
CR2
CR3
CR4
CR5
CR6
CR7
CR8
CR9
CR10
CR11
CR12
CR13
CR14
CR15
CR16
RN4
R10KX8
HEADER5X2
J20
PLD PROGRAMMING
TKBD[4:0]
LIR*
LRW
PLD_DIAG1
PLD_DIAG2
J5
J7
COP_RST*
LBOX
T12CLK_LA
BREAK_PLD
CLK_DP
ICG_CLK
CLRFLGEN
CS1
DATA_DP
MCU_DATA
DATA_OE
DIS_PA0
DIS_PA1
DIS_PA2
DIS_PA3
DIS_PA4
INTERNAL*
KEYBOARD*
LA_LE
LBOX
LIR*
LOCKOUT
LRW
OSC1_ON
OSC1
OSC2_ON
OSC2
PTB6_ON*
PTB7_ON*
PTB45_ON*
PU_PA0
PU_PA1
PU_PA2
PU_PA3
PU_PA4
RST_DP*
SCI_ON*
SCLK*
SCLK
SCLK_6*
SCLK_30*
SPARE_SW_IN
SPARE_SW_OE
PLD_OPT3
ECOS
SPARE1
SPARE2
SPARE3
SPARE4
SPARE5
OPT1
OPT2
OPT3
OPT4
NC1
NC2
NC3
NC4
NC5
NC6
NC7
NC8
BREAK*
CLRFLGEN/LIR
EMB_OSC
FG
ICGS
ICLK_H
ICLK_L
LOCKOUT*
MMDSIRQ*
RESET*
RW/LAST
SCLK_30
T_IRQ*
OSC2_EXT
PLD_OPT1
PLD_OPT2
SCLK_6
PFD_OUT
COUT_DP
SOUT_DP
SWITCH
T12CLKD
T12CLK_LA
08_IRQ
08_RST
T12CLK
BASE_FREQ
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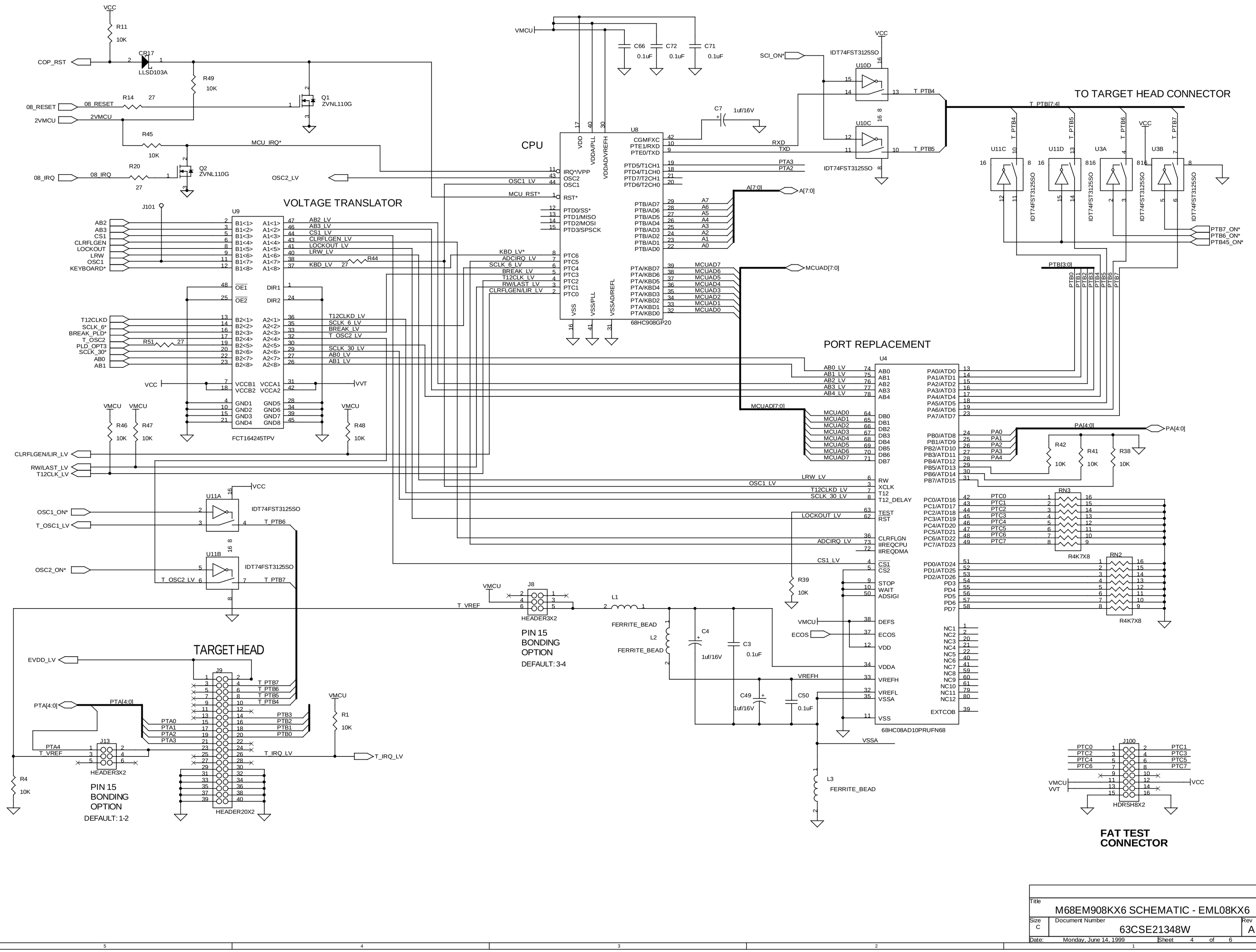
VOLTAGE TRANSLATOR
CPU
PORT REPLACEMENT
TO TARGET HEAD CONNECTOR
TARGET HEAD
FAT TEST CONNECTOR
PIN 15 BONDING OPTION
DEFAULT: 3-4
PIN 15 BONDING OPTION
DEFAULT: 1-2
FCT164245TPV
68HC908GP20
68HC08AD10PRUFN68
IDT74FST3125SO
HEADER3X2
HEADER20X2
HDRSH8X2
R4K7X8
FERRITE_BEAD
LLSD103A
ZVNL110G
VCC
VMCU
VVT
EVDD_LV
COP_RST
08_RESET
2VMCU
08_IRQ
MCU_IRQ*
OSC2_LV
OSC1_LV
MCU_RST*
KBD_LV*
ADCIRQ_LV
SCLK_6_LV
BREAK_LV
T12CLK_LV
RW/LAST_LV
CLRFLGEN/LIR_LV
LOCKOUT_LV
LRW_LV
CS1_LV
T_VREF
T_IRQ_LV
T_OSC1_LV
T_OSC2_LV
OSC1_ON*
OSC2_ON*
SCI_ON*
RXD
TXD
PTA3
PTA2
T_PTB4
T_PTB5
T_PTB6
T_PTB7
T_PTB[7:4]
PTB7_ON*
PTB6_ON*
PTB45_ON*
PTB[3:0]
A[7:0]
MCUAD[7:0]
PA[4:0]
AB0_LV
AB1_LV
AB2_LV
AB3_LV
AB4_LV
SCLK_30_LV
AB0_LV
AB1_LV
T12CLKD_LV
SCLK_6_LV
BREAK_LV
T_OSC2_LV
SCLK_30_LV
AB0_LV
AB1_LV
AB2
AB3
CS1
CLRFLGEN
LOCKOUT
LRW
OSC1
KEYBOARD*
KBD_LV
T12CLKD
SCLK_6*
BREAK_PLD*
T_OSC2
PLD_OPT3
SCLK_30*
AB0
AB1
PTA0
PTA1
PTA2
PTA3
PTA4
PTB0
PTB1
PTB2
PTB3
R1 10K
R4 10K
R38 10K
R39 10K
R41 10K
R42 10K
R44 27
R45 10K
R46 10K
R47 10K
R48 10K
R49 10K
R51 27
R14 27
R20 27
C1 1uf/16V
C3 0.1uF
C4 1uf/16V
C49 1uf/16V
C50 0.1uF
C66 0.1uF
C72 0.1uF
C71 0.1uF
L1 FERRITE_BEAD
L2 FERRITE_BEAD
L3 FERRITE_BEAD
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VOLTAGE REGULATORS

RANGE SELECT
DEFAULT: OFF

VMCU TRACKING
DEFAULT: 1-2

DIGITAL POT

CLOCK SOURCES

OSCILLATOR SELECT
DEFAULT: 3-4

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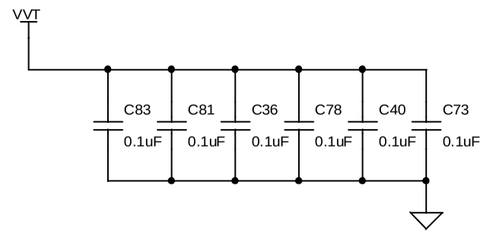

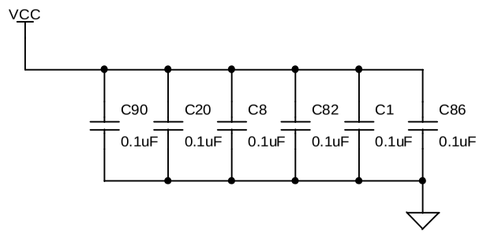

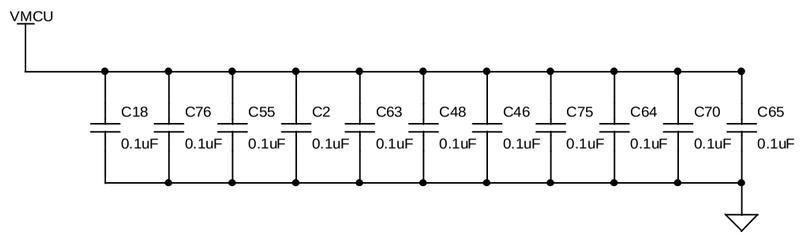

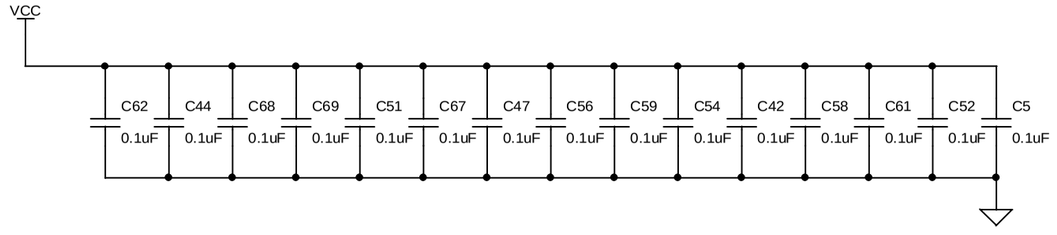

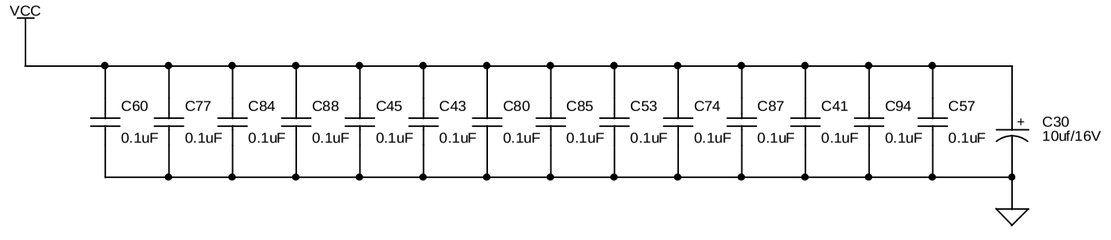

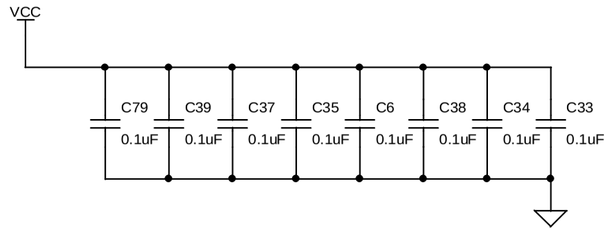

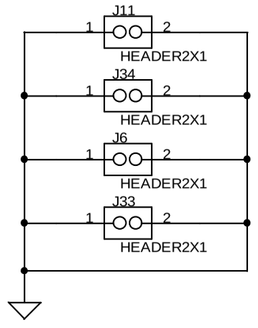

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Appendix A. Quick Start Hardware Configuration Guide

A.1 Introduction

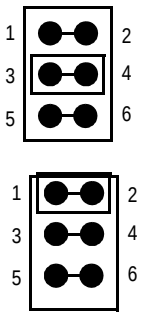
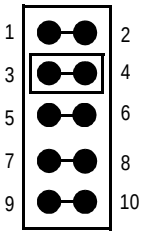
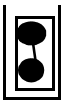
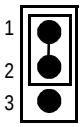
This section provides a quick start guide for those who want immediately begin use of the KXEM, without referring to the rest of the manual.

A.2 Configuring the KXEM Jumper Headers

The KXEM has five (5) jumper headers that you may configure for specific requirements (Table 0-1).

CAUTION: *The KXEM can be set to operate at a variety of voltages. When configuring the KXEM jumper headers, care must be exercised to ensure that the voltages selected for the board match those of the target device. Failure to do so can result in damage to either or both of the pieces of equipment.*

Table A-1 KXEM Jumper Header Description

Jumper Header	Type (Factory Default Shown	Description
J8 and J13 V_{REFH} bonding option		Jumper between pins 3 and 4 on jumper header J8 and jumper between pins 1 and 2 on jumper header J13 (factory default): emulates an MC68HC908KX8 with pin 15 configured as PTA4/KBD4, a standard port pin. Jumper between pins 5 and 6 on jumper header J8 and jumper between pins 3 and 4 on jumper header J13: emulates MC68HC908KX8 with pin 15 configured as V_{REFH} for A/D converters. *Note: Do not jumper to any other configuration.*
J19 MCU clock source select		Jumper between pins 1 and 2: selects the MMDS control board or MMEVS platform board as the signal source Jumper between pins 3 and 4 (factory default): selects the 8.000-MHz oscillator at location Y1 as the signal source Jumper between pins 5 and 6: selects a user-supplied crystal as the signal source; requires user to install a crystal at Y1, resistors at R8 and R52, and capacitors at C13 and C14 (See schematics in Section 3.) Jumper between pins 7 and 8: selects the timing in the user target system as the signal source Jumper between pins 9 and 10; selects the BNC connector (J28) as the signal source
J25 MCU voltage range select		Jumper between pins 1 and 2 (factory default): selects the range of R10 to be 1.2 V – 3.25 V No jumper: selects the range of R10 to be 1.9 V – 5.25 V
J29 MCU voltage reference select		Jumper between pins 1 and 2 (factory default): selects the MCU voltage to be controlled by R10 Jumper between pins 2 and 3: selects the MCU voltage to track the user's target system
J3, J4, J6, J11, J17, J20, J24, J33, J34		Factory programming, testing, and development purposes. Leave OPEN, i.e., no jumper.

A.2.1 Connecting the KXEM to MMDS and Target Device

a. Remove the top half of the MMDS.

b. Align the KXEM module with the control board of the MMDS so that connectors P1 and P2 (on the bottom of the KXEM) are matched to P1 and P2 on the control board.

c. Press P1 and P2 of the KXEM into P1 and P2 of the control board.

d. Snap the corners of the KXEM onto the plastic standoffs of the MMDS.

e. Connect one end of the Target Flex Cable to J9 on the KXEM.

f. Connect the other end of the Target Flex Cable to the appropriate connector on the target device.

g. Connect the MMDS, according to the instructions in it’s operating manual.

h. Copy the Personality Files from the disk provided to the directory that contains your debugging software. The files are:

- Em08kx6.mem Personality file for 68HC908KX6
- Em08kx6.reg Register file for 68HC908KX6
- Em08kx8.mem Personality file for 68HC908KX8
- Em08kx6.reg Register file for 68HC908KX8

NOTE: *If you are using the MCUEZ software, you will need to rename the appropriate personality and register files before executing the MCUEZ Debugger for the first time. Rename the appropriate personality file (*.mem) to "00C2BV03.MEM." Rename the appropriate register file (*.reg) to "MCUIOC2B.REG." For example, if you are going to emulate a KX8 MCU, rename "em08kx8.mem" to "00c2bv03.mem", and rename "em08kx8.reg" to "mcuioc2b.reg."*

If you are using P & E Software’s MMDS or MMEVS software, you will need to rename the appropriate personality file before executing the emulation software for the first time. The emulation software will look for the 0042BV??.MEM file in the directory containing the emulation software. Rename the appropriate personality file to "0042BV03.MEM." Note that the "V03" on the filename represents the version and may change, such as to "V04" or "V05." the software will look for the most up-to-date revision, by looking for "V06" first and progressing downwards to "V00." the "0042B" is and ID read from the emulator top board and is used to decide which personality file to load.

The register files are not used by the P & E software. The P & E software has it's own files which are included with the installation of the software.

A.2.2 Connecting KXEM to MMEVS and Target Device

a. Remove the top half of the MMDS.

b. Align the KXEM module with the platform board of the MMEVS so that connectors P1 and P2 (on the bottom of the KXEM) are matched to P1 and P2 on the platform board.

c. Press P1 and P2 of the KXEM into P1 and P2 of the platform board.

d. Snap the corners of the KXEM onto the plastic standoffs of the MMEVS.

e. Connect one end of the Target Flex Cable to J9 on the KXEM.

f. Connect the other end of the Target Flex Cable to the appropriate connector on the target device.

g. Connect the MMEVS, according to the instructions in it's operating manual.

h. Copy the Personality Files from the disk provided to the directory that contains your debugging software. The files are:

- Em08kx6.mem Personality file for 68HC908KX6
- Em08kx6.reg Register file for 68HC908KX6
- Em08kx8.mem Personality file for 68HC908KX8
- Em08kx6.reg Register file for 68HC908KX8

NOTE: *If you are using the MCUEZ software, you will need to rename the appropriate personality and register files before executing the MCUEZ Debugger for the first time. Rename the appropriate personality file (*.mem) to "00C2BV03.MEM." Rename the appropriate register file (*.reg) to "MCUIOC2B.REG." For example, if you are going to emulate a KX8 MCU, rename "em08kx8.mem" to "00c2bv03.mem", and rename "em08kx8.reg" to "mcuioc2b.reg."*

If you are using P & E Software's MMDS or MMEVS software, you will need to rename the appropriate personality file before executing the emulation

software for the first time. The emulation software will look for the 0042BV??.MEM file in the directory containing the emulation software. Rename the appropriate personality file to "0042BV03.MEM." Note that the "V03" on the filename represents the version and may change, such as to "V04" or "V05." the software will look for the most up-to-date revision, by looking for "V06" first and progressing downwards to "V00." the "0042B" is and ID read from the emulator top board and is used to decide which personality file to load. The register files are not used by the P & E software. The P & E software has it's own files which are included with the installation of the software.

Appendix B. S-Record Information

B.1 Introduction

The Motorola S-record format was devised to encode programs or data files in a printable format for transport between computer platforms. The format also provides for editing of the S records and monitoring the cross-platform transfer process.

B.2 S-Record Contents

Each S record is a character string composed of several fields which identify:

- Record type
- Record length
- Memory address
- Code/data
- Checksum

Each byte of binary data is encoded in the S record as a 2-character hexadecimal number:

- The first character represents the high-order four bits of the byte.
- The second character represents the low-order four bits of the byte.

The five fields that comprise an S record are shown in .

Table B-1. S-Record Fields

Type	Record Length	Address	Code/Data	Checksum

The S-record fields are described in .

Table B-2. S-Record Field Contents

Field	Printable Characters	Contents
Type	2	S-record type — S0, S1, etc.
Record Length	2	Character pair count in the record, excluding the type and record length.
Address	4, 6, or 8	2-, 3-, or 4-byte address at which the data field is to be loaded into memory.
Code/Data	0 – 2n	From 0 to n bytes of executable code, memory loadable data, or descriptive information. For compatibility with teletypewriter, some programs may limit the number of bytes to as few as 28 (56 printable characters in the S record).
Checksum	2	Least significant byte of the one's complement of the sum of the values represented by the pairs of characters making up the record length, address, and the code/data fields.

Each record may be terminated with a CR/LF/NULL. Additionally, an S record may have an initial field to accommodate other data such as line number generated by some time-sharing systems.

Accuracy of transmission is ensured by the record length (byte count) and checksum fields.

B.3 S-Record Types

Eight types of S records have been defined to accommodate the several needs of the encoding, transport, and decoding functions. The various Motorola upload, download, and other record transport control programs, as well as cross assemblers, linkers, and other file-creating or debugging programs, utilize only those S records which serve the purpose of the program.

For specific information on which S records are supported by a particular program, consult the user manual for the program.

NOTE: *The ICS08RKZ supports only the S0, S1, and S9 record types. All data before the S1 record is ignored. Thereafter, all records must be S1 type until the S9 record, which terminates data transfer.*

An S-record format may contain the record types in .

Table B-3. Record Types

Record Type	Description
S0	Header record for each block of S records. The code/data field may contain any descriptive information identifying the following block of S records. The address field is normally 0s.
S1	Code/data record and the 2-byte address at which the code/data is to reside.
S2 – S8	Not applicable to ICS08RKZ
S9	Termination record for a block of S1 records. Address field may optionally contain the 2-byte address of the instruction to which control is to be passed. If not specified, the first interplant specification encountered in the input will be used. There is no code/data field.

Only one termination record is used for each block of S records. Normally, only one header record is used, although it is possible for multiple header records to occur.

B.4 S Record Creation

S-record format programs may be produced by dump utilities, debuggers, cross assemblers, or cross linkers. Several programs are available for downloading a file in the S-record format from a host system to an 8- or 16-bit microprocessor-based system.

B.5 S-Record Example

A typical S-record format, as printed or displayed, is shown in this example:

Example:

```
S00600004844521B
S1130000285F245F2212226A00042429008237C2A
S11300100002000800082529001853812341001813
S113002041E900084#42234300182342000824A952
S107003000144ED492
S9030000FC
```

In the example, the format consists of:

- An S0 header
- Four S1 code/data records
- An S9 termination record

B.5.1 S0 Header Record

The S0 header record is described in .

Table B-4. S0 Header Record

Field	S-Record Entry	Description
Type	S0	S-record type S0, indicating a header record
Record Length	06	Hexadecimal 06 (decimal 6), indicating six character pairs (or ASCII bytes) follow
Address	00 00	4-character, 2-byte address field; zeroes
Code/Data	48 44 52	Descriptive information identified these S1 records: ASCII H D R — “HDR”
Checksum	1B	Checksum of S0 record

B.5.2 First S1 Record

The first S1 record is described in .

Table B-5. S1 Header Record

Field	S-Record Entry			Description	
Type	S1			S-record type S1, indicating a code/data record to be loaded/verified at a 2-byte address	
Record Length	13			Hexadecimal 13 (decimal 19), indicating 19 character pairs, representing 19 bytes of binary data, follow	
Address	0000			4-character, 2-byte address field; hexadecimal address 0000 indicates location where the following data is to be loaded	
Code/Data	Opcode			Instruction	
	28 24 22 22 00 29 08	5F 5F 12 6A 04 00 23	 24 7C	BHCC BCC BHI BHI BRSET BHCS BRSET	$0161 $0163 $0118 $0172 0, $04, $012F $010D 4, $23, $018C
Checksum	2A			Checksum of the first S1 record	

The 16 character pairs shown in the code/data field of are the ASCII bytes of the actual program.

The second and third S1 code/data records each also contain $13 (19T) character pairs and are ended with checksum 13 and 52, respectively. The fourth S code/data record contains 07 character pairs and has a checksum of 92.

B.5.3 S9 Termination Record

The S9 termination record is described in .

Table B-6. S9 Header Record

Field	S-Record Entry	Description
Type	S9	S-record type S9, indicating a termination record

Table B-6. S9 Header Record

Field	S-Record Entry	Description
Record Length	03	Hexadecimal 04, indicating three character pairs (three bytes) follow
Address	00 00	4-character, 2-byte address field; zeroes
Code/Data		There is no code/data in an S9 record.
Checksum	FC	Checksum of S9 record

B.5.4 ASCII Characters

Each printable ASCII character in an S record is encoded in binary. gives an example of encoding for the S1 record. The binary data is transmitted during a download of an S record from a host system to a 9- or 16-bit microprocessor-based system. For example, the first S1 record in is sent as shown here.

TYPE				LENGTH				ADDRESS								CODE/DATA								...	CHECKSUM			
S		1		1		3		0		0		0		0		2		8		5		F		...	2		A	
5	3	3	1	3	1	3	3	3	0	3	0	3	0	3	0	3	2	3	8	3	5	4	6	...	3	2	4	1
0101	0011	0011	0001	0011	0001	0011	0011	0011	0000	0011	0000	0011	0000	0011	0000	0011	0010	0011	1000	0011	0101	0100	0110	...	0011	0010	0100	0001

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