COMMAND AND STATUS REGISTER

RXCS, PDP-11/LSI-11, RX01 177170

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
ERR	INIT	X	X	0	X	0	0	TR	INT ENB	DONE	UNIT SEL	FUNCTION			GO

RX2CS, PDP-11/LSI-11, RX02 177170

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
ERR	INIT	EXT ADD	RX02	X	0	DEN	TR	INT ENB	DONE	UNIT SEL	FUNCTION				GO

RXCS, PDP-8, RX01 67X1

00	01	02	03	04	05	06	07	08	09	10	11
X	X	0	0	MAIN	8 BIT	X	UNIT SEL	FUNCTION			GO

RX2CS, PDP-8, RX02 67X1

00	01	02	03	04	05	06	07	08	09	10	11
X	X	0	DEN	MAIN	8 BIT	X	UNIT SEL	FUNCTION			X

FUNCTION CODES

000 FILL BUFFER
001 EMPTY BUFFER
010 WRITE SECTOR
011 READ SECTOR
100 NOT USED (RX01)
SET DENSITY (RX02)
101 READ RXES
110 WRITE WITH DEL DATA MARK
111 READ ERROR REG

ERROR AND STATUS REGISTER (Status A)

RXES, PDP-11/LSI-11, RX01 177172

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
X	X	X	X	0	0	0	X	DRV RDY	DEL DATA	0	0	WRT PROT ERR	INIT DONE	PAR ERR	CRC ERR

RX2ES, PDP-11/LSI-11, RX02 177172

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
X	X	X	X	NXM	WC OVFL	0	UNIT SEL	DRV RDY	DEL DATA	DRV DEN	DEN ERR	AC LOW	INIT DONE	0	CRC ERR

RXES, PDP-8, RX01 67X2

00	01	02	03	04	05	06	07	08	09	10	11
X	X	X	X	DRV RDY	DEL DATA	X	X	WRT PROT ERR	INIT DONE	PAR ERR	CRC ERR

RX2ES, PDP-8, RX02 67X2

00	01	02	03	04	05	06	07	08	09	10	11
X	X	X	X	DRV RDY	DEL DATA	DRV DEN	DEN ERR	RX02	INIT DONE	0	CRC ERR

SECTOR ADDRESS REGISTER

RXSA, RX2SA, PDP-11/LSI-11/PDP-8, RX01/02 67X2/177172

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
X	X	X	X	X	X	X	X	0	0	0	SECTOR ADDRESS 1.32_8				
00	01	02	03	04	05	06	07	08	09	10	11				

TRACK ADDRESS REGISTER

RXTA, RX2TA, PDP-11/LSI-11/PDP-8, RX01/02 67X2/177172

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
X	X	X	X	X	X	X	X	0	TRACK ADDRESS 0.114_8						
00	01	02	03	04	05	06	07	08	09	10	11				

WORD COUNT REGISTER

RXWC, PDP-11/LSI-11, RX02 ONLY 177172

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
X	X	X	X	X	X	X	X	0	0.100_8 (SD)	WORD COUNT					0.200_8 (DD)

BUS ADDRESS REGISTER

RX2BA, PDP-11/LSI-11, RX02 ONLY 177172

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
STARTING MEMORY ADDRESS OF DATA															

DATA BUFFER REGISTER

RXDB, PDP-11/LSI-11 177172

15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
NOT USED								DATA BYTE							

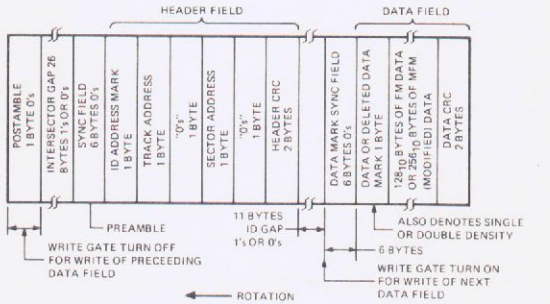
RXDB, PDP-8, RX01/RX02 67X2

00	01	02	03	04	05	06	07	08	09	10	11
DATA - 12 BIT MODE ONLY						DATA BYTE					

ERROR CODES

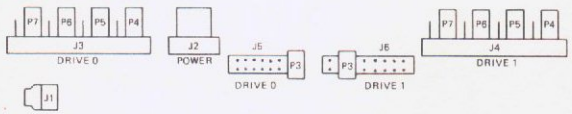
ERR REG	PDP-11, LSI-11				RX02 ONLY				
TRACK ADDR SEL DV				DV SEL	DEN DV1	HD LD	DEN DV0		DEN CMD	WORD 4
TARGET SECTOR	TARGET TRACK									
CURRENT TRACK DV1	CURRENT TRACK DV0									
WORD COUNT REG	ERROR CODE									WORD 1
15	8	7	4	0						

SECTOR FORMAT

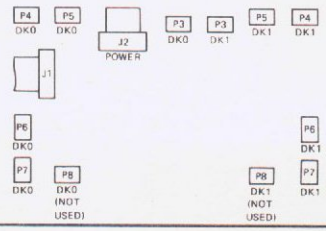


READ/WRITE CABLING

RX02 (M7745)



RX01 (M7727)



PROGRAM PROTOCOL

Read or Write Sector

RX11, V11, 211, V21 (RXO1, RXO2)

1. Test for DONE
2. Load command into RXCS
3. Wait for TR
4. Load sector # into RXSA (RXDB)
5. Wait for TR
6. Load track # into RXTA (RXDB)
7. Wait for DONE
8. Check errors

RX8; RX28 12 Bit (RXO1, RXO2)

1. Test for DONE [only if 1st command since INIT]
2. (CLA) TAD command
3. LCD
4. Wait for TR (STR)
5. TAD sector #, XDR
6. Wait for TR
7. TAD track #, XDR
8. Wait for DONE (SDN)
9. Check errors

RX28 8 Bit (insert into above) (RXO2)

3A. Move command bits 0 – 3 to AC 8 – 11
3B. Wait for TR, XDR

Set Media Density (RX02 only)

RX211, V21, 28

1. Test for DONE [RX28; only if 1st command since INIT]
2. Load command (DEN set, DD; clear, SD)
3. Wait for TR
4. Load "I" (111_8) into RXDB
5. Wait for DONE (allow 15 sec.)
6. Check errors

Read ERREG

RX211, V21 (RXO2)

1. Test for DONE
2. Load command into RX2CS
3. Wait for TR
4. Move starting memory address into RX2BA (RX2DB)
5. Wait for DONE
6. Read results in 4 word locations beginning @ address in step 4

RX11, V11 (RXO1)

1. Test for Done
2. Load command into RXCS
3. Wait for DONE
4. Read ERREG (RXDB)

RX8,28 (RXO1, RXO2)

1. (CLA) TAD command
2. LCD
3. Wait for DONE
4. XDR (ERREG in now in AC)

PROGRAM PROTOCOL (Cont)

Fill or Empty Buffer

RX11, V11 (Programmed data xfr, RXO1)

1. Test for DONE
2. Load command into RXCS
3. Set up memory address pointer
4. Wait for TR
5. Move byte to/from RXDB-memory, increment pointer
6. TR or DONE?
7. If TR and not DONE, back to step 4
8. If DONE and not TR, check errors

RX211, V21 (DMA, RXO2)

1. Test for DONE
2. Load command into RXCS
3. Wait for TR
4. Move word count to RX2WC (RX2DB)
5. Wait for TR
6. Move starting memory address to RX2BA (RX2DB)
7. Wait for DONE
8. Check errors

RX8; RX28 12 Bit (Programmed data xfr, RXO1, RXO2)

1. Test for DONE [only if 1st command since INIT]
2. (CLA) TAD command
3. LCD
4. Wait for TR (STR)
5. FILLBUF: TAD from memory, XDR EMPTBF: XDR, DCA to memory
6. TR or DONE?
7. If TR and not DONE, back to step 5
8. If DONE and not TR, check errors

RX28 8 Bit (insert into above) (RXO2)

4. Move command bits 0 – 3 to AC 8 – 11
4A. Wait for TR, XDR
4B. Wait for TR

Read Status (RXES)

RX11, V11, 211, V21, 8, 28 (RXO1, RXO2)

[if previous command was not Read ERREG]

1. Test for DONE
2. Read RXES (RXDB)

[if last command was Read ERREG on RX8, 11, V11; or if current DRV RDY condition req., or current DRV DEN on RX02]

1. Test for DONE
2. Load command
3. Wait for DONE
4. Read RXES (RXDB)

NOTE: INTERRUPTS OCCUR ON DONE (IF INT ENB) BUT NOT ON TR

SWITCH & JUMPER CONFIGURATIONS

RXO2 CONTROLLER MODULE (M7744) CONFIGURATION SWITCH

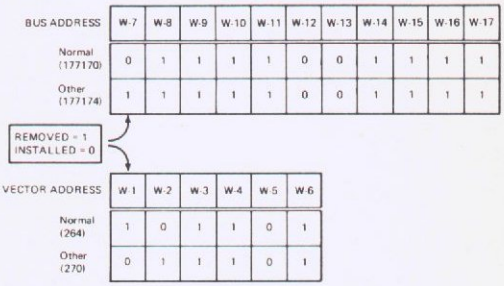
(M-7744)	S1-1	S1-2
RX8, RX11, RXV11	ON	OFF
RX28	OFF	ON
RXV21, RX211	OFF	ON

NOTE : To Read Single Density Disk (RXO1 Type) on RXO2 — Do NOT Change Switches.

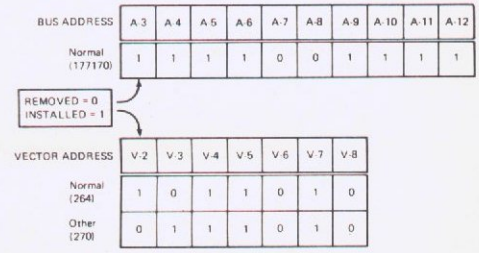
INTERFACE MODULES RX8 & RX28 (M8357)

RX11 (M7846) RX211 (M8256)

RXV11 (M7946)



RXV21 (M8029)



PDP-8 BOOTSTRAPS

	RX8	RX28
	00024 7126	00020 1061
	25 1060	21 1046
	26 67X1	22 0060
	27 7201	23 3061
	30 4053	24 7327
	31 4053	25 1061
	32 7104	26 67X1
STA →	33 67X5	27 7301
	34 5054	30 4053
	35 67X4	31 4053
	36 7450	32 7004
	37 7610	STA → 33 67X5
	40 5046	34 5054
	41 1060	35 67X4
	42 7041	36 7450
	43 1061	37 5020
	44 3060	40 1061
	45 5024	41 67X1
	46 67X1	42 1061
	47 4053	43 0046
	50 3002	44 1032
	51 2050	45 3060
	52 5047	46 0360
	53 0000	47 4053
	54 67X3	50 3002
	55 5033	51 2050
	56 67X2	52 5047
	57 5453	53 0000
	60 7024	54 67X3
	61 6030	55 5033
		56 67X2
		57 5453
		60 0420
		61 0020

DIAGNOSTICS

RX11/V11

ZRXA (X) System Rel.
ZRXB (X) Interface Diag.

RX8/28

IRXA (X) Diagnostic
IRXB (X) Data Rel.

RX211/V21

ZRXC (X) Utility Dvr.
ZRXD (X) Perf. Exc.
ZRXE (X) Formatter
ZRXF (X) Logic Function Test

X = Revision Level

PDP-11 BOOTSTRAPS

RX11/V11

01000	005000
1002	012701
1004	177170
1006	105711
1010	001776
1012	012711
1014	000003
1016	005711
1020	001776
1022	100405
1024	105711
1026	100004
1030	116120
1032	000002
1034	000770
1036	000000
1040	005000
1042	000110

RX211/V21

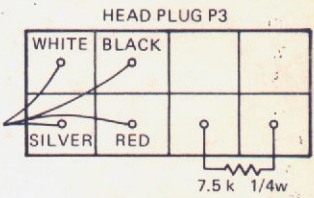
2000	012701
2002	177170
2004	012700
2006	100240
2010	005002
2012	012705
2014	000200
2016	012704
2020	000401
2022	012703
2024	177172
2026	030011
2030	001776
2032	100440
2034	012711
2036	000407
2040	030011
2042	001776
2044	100433
2046	110413
2050	000304
2052	030011
2054	001776
2056	110413
2060	000304
2062	030011
2064	001776
2066	100422
2070	012711
2072	000403
2074	030011
2076	001776
2100	100415
2102	010513

RX211/V21 Cont.

2104	030011
2106	001776
2110	100411
2112	010213
2114	060502
2116	060502
2120	122424
2122	120427
2124	000007
2126	003737
2130	005000
2132	005007
2134	000000

70 – Drive used with M7727 R/W must have resistor installed.

70 – Drive used with M7745 must NOT have resistor.



Ref: RXO1–TT–19

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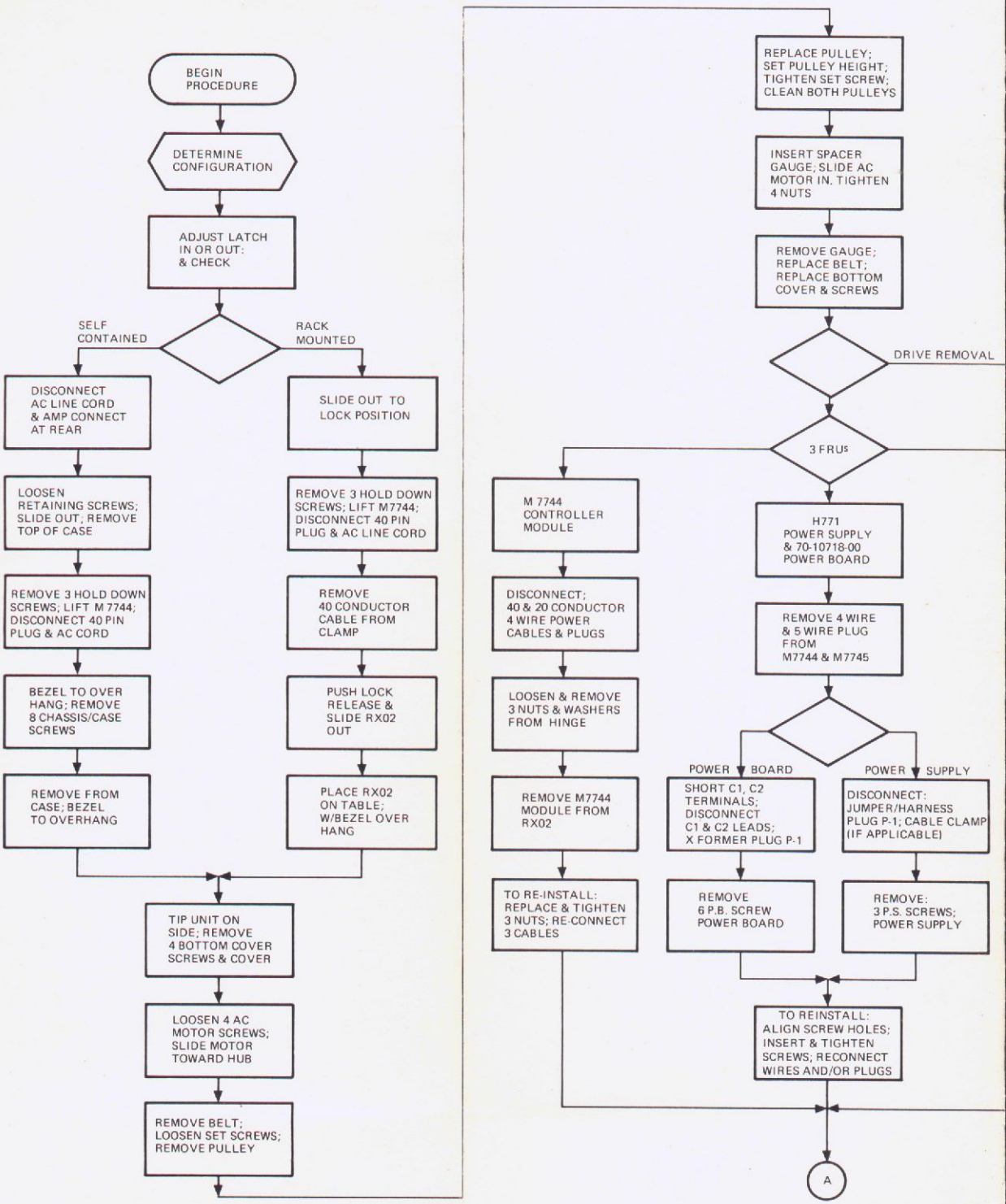
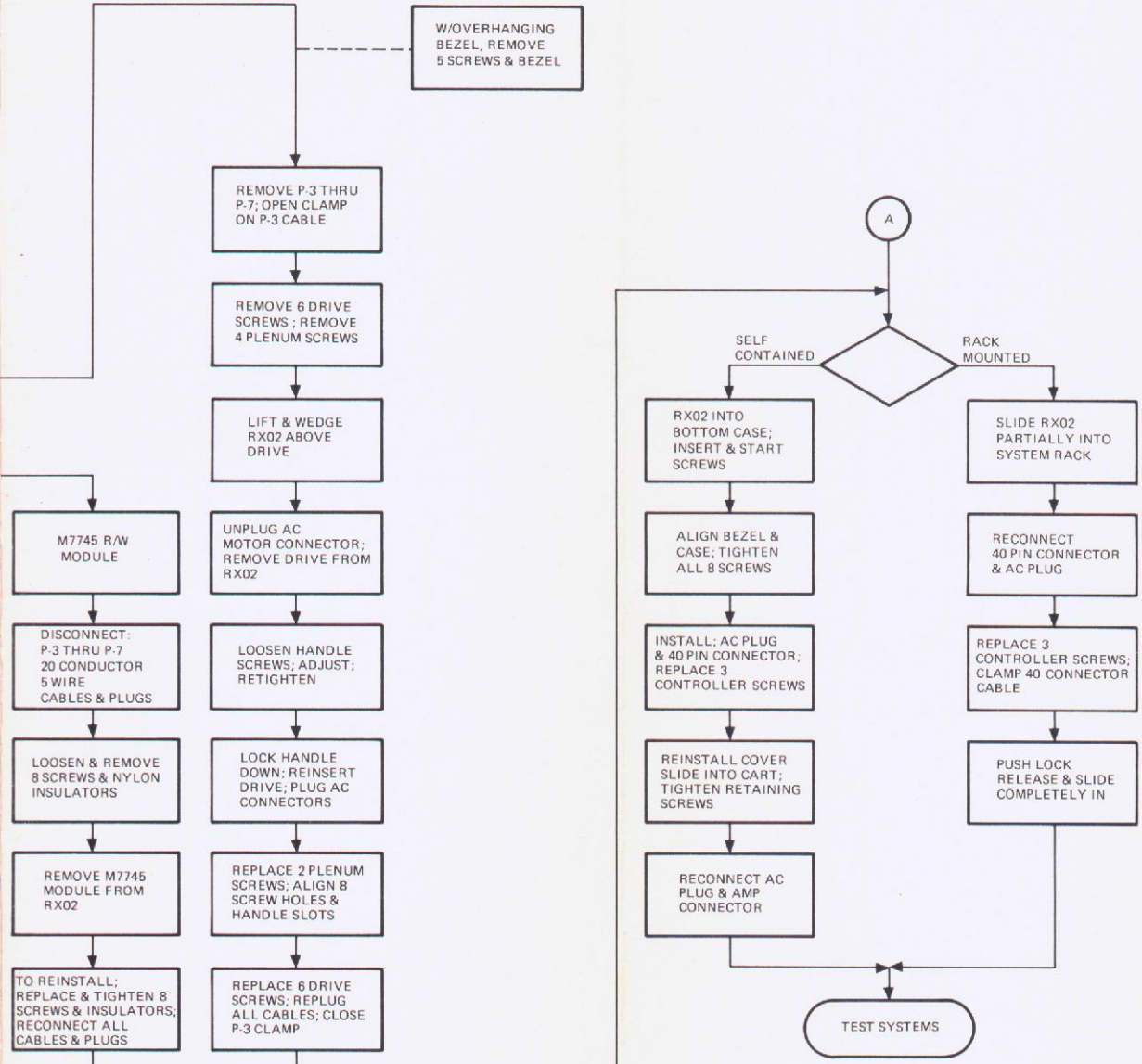
EK-RX102-RC-001

RX02 DISASSEMBLY/REASSEMBLY




W/OVERHANGING BEZEL, REMOVE 5 SCREWS & BEZEL
REMOVE P-3 THRU P-7; OPEN CLAMP ON P-3 CABLE
REMOVE 6 DRIVE SCREWS ; REMOVE 4 PLENUM SCREWS
LIFT & WEDGE RX02 ABOVE DRIVE
UNPLUG AC MOTOR CONNECTOR; REMOVE DRIVE FROM RX02
LOOSEN HANDLE SCREWS; ADJUST; RETIGHTEN
LOCK HANDLE DOWN; REINSERT DRIVE; PLUG AC CONNECTORS
REPLACE 2 PLENUM SCREWS; ALIGN 8 SCREW HOLES & HANDLE SLOTS
REPLACE 6 DRIVE SCREWS; REPLUG ALL CABLES; CLOSE P-3 CLAMP
REINSTALL BEZEL W/5 SCREWS
M7745 R/W MODULE
DISCONNECT: P-3 THRU P-7 20 CONDUCTOR 5 WIRE CABLES & PLUGS
LOOSEN & REMOVE 8 SCREWS & NYLON INSULATORS
REMOVE M7745 MODULE FROM RX02
TO REINSTALL; REPLACE & TIGHTEN 8 SCREWS & INSULATORS; RECONNECT ALL CABLES & PLUGS
A
SELF CONTAINED
RACK MOUNTED
RX02 INTO BOTTOM CASE; INSERT & START SCREWS
ALIGN BEZEL & CASE; TIGHTEN ALL 8 SCREWS
INSTALL; AC PLUG & 40 PIN CONNECTOR; REPLACE 3 CONTROLLER SCREWS
REINSTALL COVER SLIDE INTO CART; TIGHTEN RETAINING SCREWS
RECONNECT AC PLUG & AMP CONNECTOR
SLIDE RX02 PARTIALLY INTO SYSTEM RACK
RECONNECT 40 PIN CONNECTOR & AC PLUG
REPLACE 3 CONTROLLER SCREWS; CLAMP 40 CONNECTOR CABLE
PUSH LOCK RELEASE & SLIDE COMPLETELY IN
TEST SYSTEMS

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RX01/ RX02 REFERENCE CARD

TRACKS/DISK	77 ($0\text{-}76_{10}$; $0\text{-}114_{8}$)
SECTORS/TRACK	26 ($1\text{-}26_{10}$; $1\text{-}32_{8}$)
TRACK TO TRACK MOVE	6 ms max
HEAD SETTLE TIME	25 ms max
ROTATION SPEED	360 rpm; 166.7 ms/rev
TRACK DENSITY	48 tracks/inch
RECORDING TECHNIQUE	Single density: FM (Double Frequency) Double density: Modified MFM (Miller)
AVERAGE ACCESS TIME	262 ms
SECTOR TIME	6 ms (Data 4.16 ms)
HARD INDEX MARK TIME	3 ms (approx.)
OPERATING TEMPERATURE	59° to 90° (F), 15° to 32° (C)
DISK LIFE	3 million revolutions/track, head loaded

RX8, RX28 INSTRUCTIONS

67X0	NOP	No operation (RX8,RX28)
	SEL	Select drive pair: AC11=0 pair A; =1 pair B (VT78 only)
67X1	LCD	Load command, clear AC (RX28 – second byte 67X2 if 8 bit mode)
67X2	XDR	Transfer RXDB to/from AC
67X3	STR	Skip on TR flag, clear flag
67X4	SER	Skip on Error flag, clear flag
67X5	SDN	Skip on Done flag, clear flag
67X6	INTR	Interrupt Enable (AC11=1) Disable (AC11=0)
67X7	INIT	Initialize

X=LSD of Device Code

Normal Device Codes: 1st RX (#75) X=5 (always in VT78)

2nd RX (#76) X=6

PDP-11 BUS STRUCTURE

1ST RX		
NORMAL VECTOR	264	264
NORMAL BR LEVEL	BR5	BR5
177170	RXCS	RX2CS
177172	RXDB,RXES RXSA, RXTA, ERREG	RX2DB, RX2ES, RX2SA, RX2TA, RX2WC, RX2BA
2ND RX		
NORMAL VECTOR	270	270

DATA CAPACITY

RX01 8 Bit Mode (RX11, RXV11, RX8E)
RX02 Single Density, 8 Bit (RX211, RXV21, RX28)
PDT 11/150
- $256,256_{10}$ Bytes/Disk ($764,400_8$)
- 3328_{10} Bytes/Track (6400_8)
- 128_{10} Bytes/Sector (200_8)
- 1024_{10} Bits/Sector

RX01 12 Bit Mode (RX8E, VT78)
RX02 Single Density, 12 Bit (RX28)
- $128,128_{10}$ Words/Disk ($372,200_8$)
- 1664_{10} Words/Track (3200_8)
- 64_{10} Words/Sector (100_8)
- 768_{10} Bits/Sector

RX02 Double Density, 8 Bit (RX211, RXV21, RX28)
- $512,512_{10}$ Bytes/Disk ($1,751,000_8$)
- 6656_{10} Bytes/Track ($15,000_8$)
- 256_{10} Bytes/Sector (400_8)
- 2048_{10} Bits/Sector

RX02 Double Density, 12 Bit (RX28)
- $256,256_{10}$ Words/Disk ($764,400_8$)
- 3328_{10} Words/Track (6400_8)
- 128_{10} Words/Sector (200_8)
- 1536_{10} Bits/Sector

CONFIGURATIONS

	RX01			RX02 used as RX01		RX02		
	RX11	RXV11	RX8E	RX11	RXV11	RX28	RX211	RXV21
Interface	M7846	M7946	M8357	M7846	M7946	M8357	M8256	M8029
Controller	M7726	M7726	M7726	M7744	M7744	M7744	M7744	M7744
Read/Write	M7727	M7727	M7727	M7745	M7745	M7745	M7745	M7745

DATA TRANSFER METHOD

Programmed: RX8, RX28, RX11, RXV11

DMA: RX211, RXV21

DATA TRANSFER RATE

	RX01	RX02 S.D.	RX02 D.D.
Drive to Controller, per bit	4 μs	4 μs	2 μs
Controller to interface, per bit	1.6 μs	1.2 μs	1.2 μs

ERROR CODE PROBABLE CAUSE

010	020	030	040	050	060	070	100	110	120	130	140	150	160	170	200	210	220	230	240	250
D	D	D	E	C	B	A	C	A	A	A	B	C	C	A	A	B	C	E	A	E
B	B	B	B	D	F	C	B	C	C	C	F	D	D	C	C	E	B	B	B	B
C	C	C		B	E	D		D	D	B	E	B	B	B	B	F			E	
						B		B	B										C	
						E			G											
									E											

A - Diskette
B - Controller
C - R/W electronics
D - Drive
E - Interface module
F - Cables
G - Power supply

ERROR CODES (Status B)

OCTAL CODE	ERROR CODE MEANING
0010	Drive 0 failed to see home on Initialize.
0020	Drive 1 failed to see home on Initialize.
* 0030	Found Home when stepping in 10 tracks for Init.
0040	Tried to access a track greater than 76.
0050	Home was found before desired track was reached.
* 0060	Self diagnostic error (Init).
0070	Desired sector could not be found after looking at 52 headers (2 revolutions).
* 0100	Write command on a write protected drive.
0110	More than 40 μs and no SEP clock seen.
0120	A preamble could not be found.
0130	Preamble found but no ID mark found within allowable time span.

OCTAL CODE	OCTAL CODE MEANING
* 0140	CRC Error on a header, Err not asserted.
0150	The header track address of a good header does not compare with the desired track.
0160	Too many tries for an IDAM (identifies header).
0170	Data AM not found in allotted time.
0200	CRC error on reading the sector from the disk. No code appears in the ERREG.
* 0210	Parity Error on a word from I/F to Controller.
† 0220	R/W electronics failed maintenance mode test.
† 0230	Word count overflow.
† 0240	Density Error.
† 0250	Wrong key word for set media density command.
** 0260	Indeterminate media density (RX02 only)
** 0270	write format failure
** 0350	Nonexistant memory error during DMA
** 0360	Drive not ready (Door open, speed error, etc)
** 0370	low dc power caused abort of write

*RX01 ONLY
†RX02 ONLY
** DSD only