

PAUL STEINERT



western peripheralsTM
Division of WESPERCORP

INSTRUCTION REFERENCE CARD

**For Digital Equipment Corporation
PDP-11 Compatible**

**DC-230 Universal Disc Controllers and
TC-130 Universal Magnetic Tape Controllers**

**WESTERN PERIPHERALS
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TUSTIN, CA 92680
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DC-230

INTERRUPT VECTOR = 220

1. DRIVE STATUS REGISTER 777400 (RKDS)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DRIVE IDENT			Drive Unsafe	X	Drive Unsafe	X	Sector OK	Drive Ready	R/W/S Ready	Write Protect	SC = SA	SECTOR COUNTER			

BITS

- 15-13 These bits will contain the binary address of the drive that has caused a motion interrupt.
- 12 & 10 These bits indicate an unusual condition in the drive.
- 11 Not used.
- 9 Not used.
- 8 Sector Counter OK indicates that the selected sector (Bits 0-3) is stable and ready for examination.
- 7 Drive Ready indicates that the selected drive is ready for remote operation.
- 6 This bit indicates drive is ready to accept a new function.
- 5 Set when disk is in Write Protect Mode.
- 4 Sector Counter equals Sector Address.
- 3-0 Sector Counter.

2. ERROR REGISTER 777402 (RKER)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DRE	OVR	WLO	SKE	PGE	NXM	DLT	TE	NXD	NXC	NXS	X	X	X	CSE	WCE

BITS

- 15 Drive Error
- 14 Overrun
- 13 Write Lockout Violation
- 12 Seek Error
- 11 Program Error
- 10 Non-Existent Memory
- 9 Data Late

BITS

- 8 Timing Error
- 7 Non-Existent Disk
- 6 Non-Existent Cylinder
- 5 Non-Existent Sector
- 1 Checksum Error
- 0 Write Check Error

DC-230

3. CONTROL STATUS REGISTER 777404 (RKCS)

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ERR	HE	SCP	X	INH BA	FMT	X	SSE	RDY	IDE	XBA 17	XBA 16	FUNCTION			GO

BITS

- 15 **Error** — Set when any bit in Error Register is set.
- 14 **Hard Error** — Set when any bit (5-15) in Error Register is set.
- 13 **Search Complete** — This bit indicates that the interrupt was a result of a previous Function Motion.
- 11 **Inhibit Inc.** — Inhibits incrementing the Bus Address.
- 10 **Format** — Used in formatting the pack.
- 8 **Stop on Soft Error** — This bit set causes Controller action to halt when Soft Error is encountered.
- 7 **Controller Ready** — Controller is ready to accept a command.
- 6 **Interrupt on Done Enable**
- 5-4 **Memory Extension Bits** — XBA 17 and XBA 16
- 3-1 **Function**

000	Control Reset	100	Seek
001	Write	101	Read Check
010	Read	110	Drive Reset
011	Write Check	111	Write Lock

- 0 **GO** — Initiates Action indicated in Bits (1-3)

4. WORD COUNT REGISTER 777406 (RKWC)

15															0
2'S COMPLEMENT OF TOTAL NUMBER OF WORDS															

5. CURRENT BUS ADDRESS REGISTER 777410 (RKBA)

15															0
CURRENT BUS ADDRESS															

6. DISK ADDRESS REGISTER 777412 (RKDA)

15	13	12					5	4	3							0
DRIVE SELECT		CYLINDER ADDRESS								SUR	SECTOR ADDRESS					

BITS

- 15-13 **Drive Select** — Address of drive currently being selected.
- 12-5 **Cylinder Address** — Address of cylinder currently being selected.
- 4 **Surface** — 0 = Upper Surface
1 = Lower Surface
- 3-0 **Sector Address** — Address of next sector.

PDP-11 INSTRUCTION LIST

GENERAL REGISTER ADDRESSING



Mode	Description	Symbolic
0	register	R
1	register deferred	@ R or (R)
2	auto-increment	(R) +
3	auto-increment deferred	@ (R) +
4	auto-decrement	-(R)
5	auto-decrement deferred	@ -(R)
6	indexed	$\pm X(R)$
7	indexed deferred	@ $\pm X(R)$ or @ (R)

($\pm X$ is an index word)

PC REGISTER ADDRESSING



Mode	Description	Symbolic
2	immediate	#n
3	absolute	@ #A
6	relative	A
7	relative deferred	@ A

MNEMONIC	INSTRUCTION	OP CODE	Cond Codes NZVC
MOV(B)	MOVE	■ 1SSDD	**0—
CMP(B)	CoMPare	■ 2SSDD	****
BIT(B)	BlT Test	■ 3SSDD	**0—
BIC(B)	BlT Clear	■ 4SSDD	**0—
BIS(B)	BlT Set	■ 5SSDD	**0—
ADD	ADD	06SSDD	****
SUB	SUBtract	16SSDD	****
HALT	HALT	000000	—
WAIT	WAit for InTerrupt	000001	—
RTI	ReTurn from Interrupt	000002	****
RESET	RESET	000005	—
CLC	CLEAR C	000241	—0
CLV	CLEAR V	000242	—0—
CLZ	CLEAR Z	000244	—0—
CLN	CLEAR N	000250	0—
SEC	SET C	000261	—1
SEV	SET V	000262	—1—
SEZ	SET Z	000264	—1—
SEN	SET N	000270	1—
—	No Operation	000240	—
—	No Operation	000260	—

MNEMONIC	INSTRUCTION	OP CODE	Cond Codes NZVC
CLR(B)	CLear	■ 050DD	0100
COM(B)	COMplement	■ 051DD	**01
INC(B)	INCrement	■ 052DD	***_
DEC(B)	DECrement	■ 053DD	***_
NEG(B)	NEGate	■ 054DD	****
ADC(B)	ADd Carry	■ 055DD	****
SBC(B)	SuBtract Carry	■ 056DD	****
TST(B)	TeST	■ 057DD	**00
ROR(B)	ROtate Right	■ 060DD	****
ROL(B)	ROtate Left	■ 061DD	****
ASR(B)	Arith. Shift Right	■ 062DD	****
ASL(B)	Arith. Shift Left	■ 063DD	****
JMP	JuMP	0001DD	—
SWAB	SWAp Bytes	0003DD	**00
JSR	Jump to Sub Routine	004RDD	—
RTS	ReTurn from Sub.	00020R	—

MNEMONIC	INSTRUCTION	OP CODE
BR	BRanch always	000400 + XXX
BNE	Branch if Not Equal (zero)	001000 + XXX
BEQ	Branch if EQual (zero)	001400 + XXX
BGE	Branch if Greater or Equal	002000 + XXX
BLT	Branch if Less Than (zero)	002400 + XXX
BGT	Branch if Greater Than (zero)	003000 + XXX
BLE	Branch if Less or Equal (zero)	003400 + XXX
BPL	Branch if PPlus	100000 + XXX
BMI	Branch if MInus	100400 + XXX
BHI	Branch if Higher	101000 + XXX
BLOS	Branch if LOver or Same	101400 + XXX
BVC	Branch if oVerflow Clear	102000 + XXX
BVS	Branch if oVerflow Set	102400 + XXX
BCC/BHIS	Branch if Carry Clear	103000 + XXX
BCS/BLO	Branch if Carry Set	103400 + XXX

TC-130

INTERRUPT VECTOR = 224

1. STATUS REGISTER (MTS) 772520

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ILL COM	EOF	X	PAE	BGL	EOT	RLE	BTE	NXM	SELR	BOT	7CH	SDWN	WRL	RWS	TUR

BITS

- 15 Illegal Command — The last command was illegal.
- 14 End of File detected during the last operation.
- 13 Not used.
- 12 Parity Error detected during last operation.
- 11 Bus Grant Late — NPR not granted before data buffer was overflowed or emptied.
- 10 End of Tape — Tape is positioned at or beyond EOT marker.
- 9 Record Length Error — Last record read was longer than requested.
- 8 Bad Tape Error — NRZ bit dropouts (indicates bad oxide coating).
- 7 Non-Existent Memory — Addressed memory does not exist.
- 6 Select Remote — Addressed drive is ON-LINE.
- 5 Beginning of Tape — Drive is positioned at BOT marker.
- 4 Seven-track tape drive is selected.
- 3 Settle Down — Tape drive is decelerating. New command OK if same direction, or different drive.
- 2 Write Lock — Protect ring removed from tape reel.
- 1 Rewind Status — Selected tape drive is rewinding.
- 0 Tape Unit Ready.

TC-130

2. COMMAND REGISTER (MTC) 772522

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ERR	DEN8	DEN5	PCLR	PEVN	SEL4	SEL2	SEL1	CUR	INT ENB	XBA 17	XBA 16	FUN 4	FUN 2	FUN 1	GO

BITS

15 Error — 'OR' function of bits 7-15 of the Status Register (MTS).

14-13 Density: Select

# of Tracks	Bit 14 Den 8	Bit 13 Den 5	Density Format
7	0	0	200 bpi NRZI
7	0	1	556 bpi NRZI
7	1	0	800 bpi NRZI
7	1	1	800 bpi NRZI Core Dump
9	1	X	800 bpi NRZI
9	0	X	1600 bpi P.E.

12 Power Clear — Clears the controller and resets the registers.

11 Parity Even — Allows even parity to be written or read (7-trk).

10-8 Unit Select — Selects one of eight tape drives.

7 Control Unit ready to accept a command.

6 Interrupt Enable — Allows the controller to interrupt the CPU at the completion of its operation.

5-4 Extended Bus Address Bits — Selects extended fields for write or read operation.

3-1 Function:

0 0 0	=	Off Line
0 0 1	=	Read
0 1 0	=	Write
0 1 1	=	Write EOF
1 0 0	=	Space Forward*
1 0 1	=	Space Reverse*
1 1 0	=	Write with Extended Gap
1 1 1	=	Rewind

0 GO — Begin operation defined by function bits.

*Spaces the number of blocks defined in the Byte Counter (MTBRC). However spacing is always terminated by detection of EOF regardless of blocks to be spaced.

TC-130

3. BYTE RECORD COUNTER (MTBRC) 772524



4. CURRENT MEMORY ADDRESS (MTCMA) 772526

Always points to the next address to be acted upon.

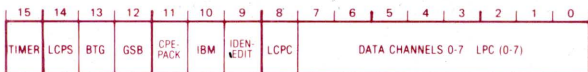


NOTE: XBA16 and XBA17 are in the Command Register (MTC 772522), bits 4 and 5.

5. DATA BUFFER REGISTER (MTD) 772530

The data buffer is a temporary storage register which is used during a Read or Write. At the completion of a Read the MTD will contain either the LRC or the CRC depending upon bit 14 of the MTRD register.

6. DRIVE READ LINES (MTRD) 772532



BITS

- 15 Timer — 10 KHz signal for diagnostic purposes.
- 14 CRC-LRC — Character select for the MTD register.
- 13 B.T.G. — Bit Error Generation for diagnostic to simulate bad tape.
- 12 GSB — Gap Shut-Down Bit for diagnostics.
- 11 CPE/PACK — Bit designates that there was a corrected Parity Error (PE). In Write this bit forces core dump mode in 7 track.
- 10 IBM — Inverts the order of the bytes on tape to conform to the IBM convention.
- 9 IDEN/EDIT — Status bit that indicates the ID burst was detected on a Phase Encoded (PE) tape. Also used as a command for Edit (overwrite) operations.
- 8 Parity Data Bit.
- 7-0 Data bits for channels (0-7).