

MV1815

SINGLE CHIP TELETEX DECODER FOR 625 LINE OPERATION

(Supersedes Version in April 1994 Consumer IC Handbook, HB3120-2.0)

The MV1815 is an advanced CMOS single chip Teletext decoder for 625 line World System Teletext. The MV1815 has an on-chip data slicer circuit, dual page acquisition circuits, and direct memory addressing which allow a low cost Teletext decoder to be built with a minimum number of additional components.

FEATURES

- On-Chip data slicing
- Up to 254 display pages stored, using low cost 150ns DRAMS
- Low external component count
- I²C Bus for low cost interfacing
- Multi-language capability for fourteen European languages
- Special parity inhibit for TOP 8-bit data
- Non-display packets stored for linked page operation, video programming, etc.
- high resolution characters typically 12 dots wide on a 15 by 10 matrix
- Accepts all non-display packets
- On-chip video switch
- Advanced CMOS technology gives low power dissipation and high reliability

ABSOLUTE MAXIMUM RATINGS

Supply Voltage, V _{DD}	-0.3V to +7.0V
All inputs	-0.3V to V _{DD} + 0.3V
Operating Temperature	0°C to 70°C
Storage Temperature	-65°C to + 150°C

ORDERING INFORMATION

MV1815-2A	BA DP	West European version
MV1815-2	BA GP	West European version
MV1815-2A	BA GPTS	West European version (Tape & reel)

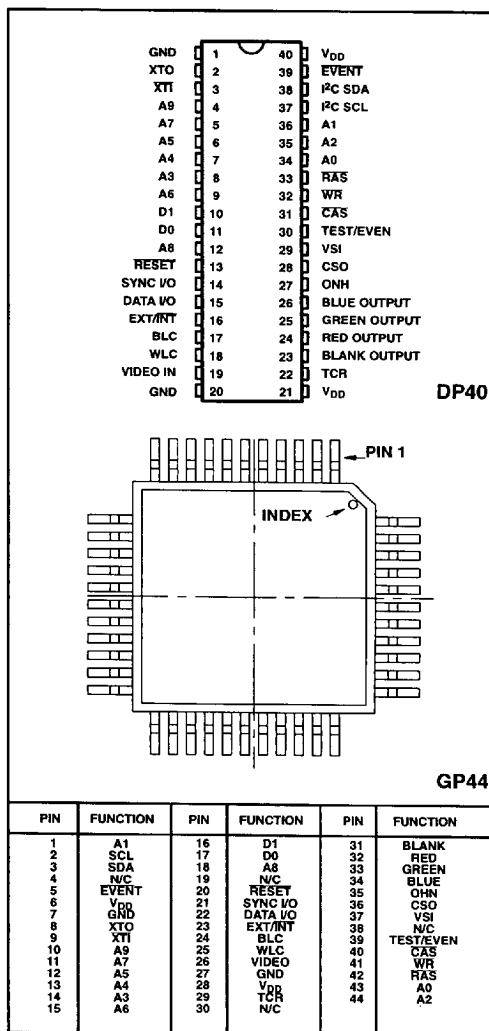


Fig. 1 Pin connections – top view

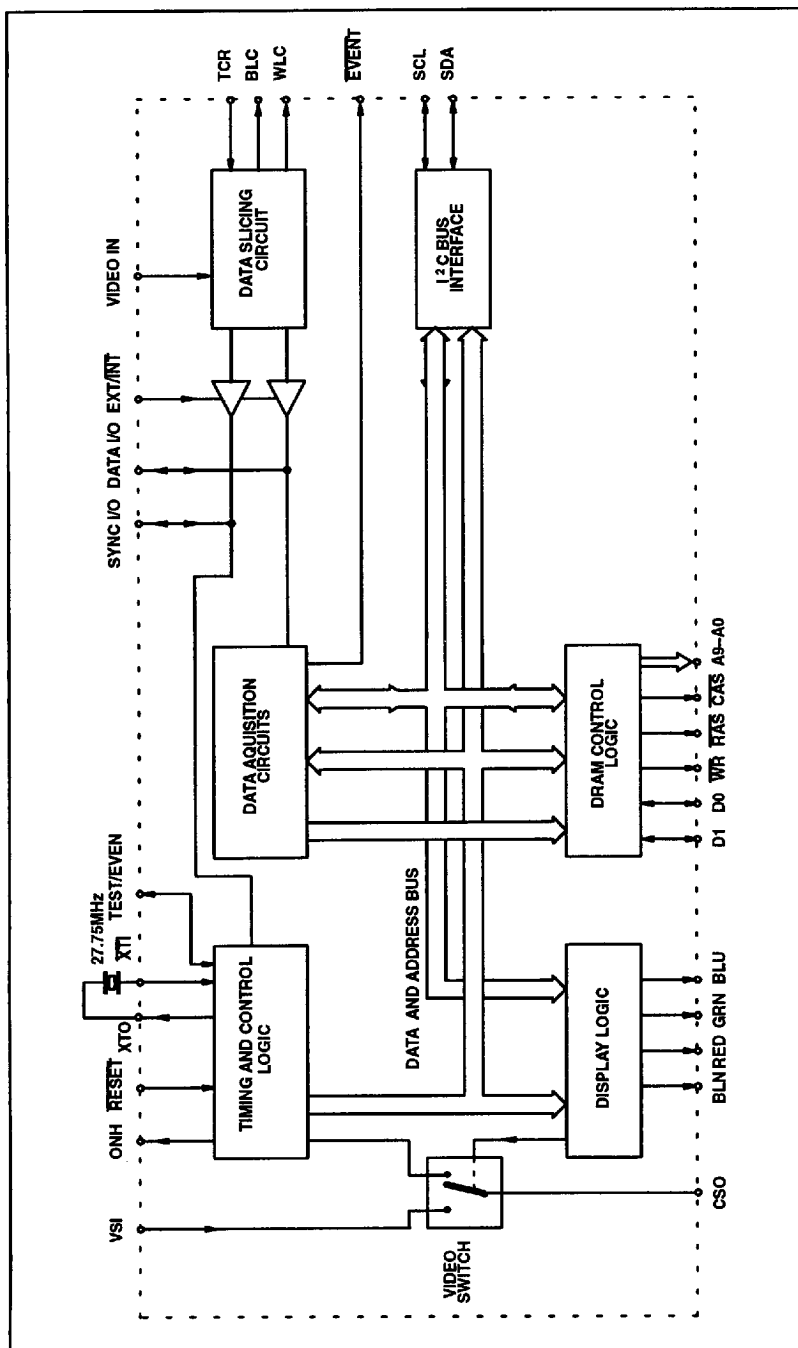


Fig. 2 MV1815 block diagram

Section	Specification											
Data Acquisition Logic Line Standard Teletext data rate Data line content TV lines used VBI TV lines used full field Packets accepted Page numbers Page subcodes	625 Lines 50 Fields/second 6.9375 Mbits/sec ±25ppm 360 bits as 45 bytes of 8 bits each Lines 6 to 22 and 318 to 335 All TV Lines ×/0 to ×/25, ×/26, ×/27, ×/28, ×/29, ×/30 (all formats), ×/31 000 to 7FF 0000 to 3F7F											
Display Logic Characters per row Teletext rows displayed TV lines used Character definition Character Sets Spacing control characters Data boxing into picture Displayable page stores Display options	40, occupying 43.24μs of the 52μs display time 0 to 23 with 24 and 25 software programmable <table border="1"><tr><th rowspan="2">Rows Displayed</th><th colspan="2">TV Lines</th></tr><tr><th>Start</th><th>Finish</th></tr><tr><td>24</td><td>48</td><td>287</td></tr><tr><td>25 or 26</td><td>38</td><td>297</td></tr></table> 15×10 dot matrix English, German, Swedish, Italian, French, Spanish, Czechoslovakian, Polish, Romanian, Hungarian, Turkish, Danish, Serbo-Croat, ASCII Standard Level One Range Page Number – Row 0 characters 1 to 8 Page Header – Row 0 characters 9 to 32 Clock Time – Row 0 characters 33 to 40 Rows 24 and 25 Up to 254 pages, each of 1k bytes, depending on the size of the DRAM being used Mix of text foreground and picture background Three part magnify – display rows 0 to 11 double height display rows 6 to 17 double height display rows 12 to 23 double height Boxing of Newflash and Subtitles into picture Boxing of picture into text	Rows Displayed	TV Lines		Start	Finish	24	48	287	25 or 26	38	297
Rows Displayed	TV Lines											
	Start	Finish										
24	48	287										
25 or 26	38	297										
Dynamic RAM Control Logic Memory Configuration Maximum access time (t _{RAC}) Refresh period for complete memory	All sizes: Page or nibble mode types 254 pages – 2 off 1M×1 or 1 off 1M×4 62 pages – 2 off 256k×1 or 1 off 256k×4 14 pages – 2 off 64k×1 or 1 off 64k×4 150ns 2.048ms Refresh occurs during the line flyback period. Contents of any memory location may be accessed by the microprocessor via the I ² C Bus Interface											
I²C Bus Interface	Standard implementation of a slave transmitter/receiver Control of the MV1815 is via the I ² C Bus Interface											
I²C Bus Address	0010 001 R/W											

Table 1. MV1815 System specification

PIN DESCRIPTION		
Symbol	Pin No (DP 40)	Pin name and Description
GND	1, 20	Ground, both pins must be connected
XTO	2	Crystal out 27.75MHz fundamental crystal with an on-chip 1M Ω bias resistor to XT1
XTI	3	Crystal input
A9, A7, A5, A4, A3, A6, A8, A0, A2, A1	4 – 9 12, 34, 35, 36	DRAM address outputs
D1, D0	10, 11	DRAM data lines. Internal 100k Ω pull – up resistors are included.
RESET	13	Active low reset input. Includes 100k Ω pull – up resistor.
SYNC I/O	14	Sliced sync input / output.
DATA I/O	15	Teletext data input / output
EXT/INT	16	Control pin for SYNC and DATA I/O. Includes 100k Ω pull-down resistor. When low or not connected internal SYNC and DATA are used, pins 14 & 15 are outputs. When high supply SYNC and DATA from an external source, pins 14 & 15 are inputs.
BLC	17	Black level capacitor.
WLC	18	White level capacitor
VIDEO IN	19	Input for composite video signal with negative going SYNCs.
VDD	21, 40	+5V Supply. Both pins must be connected.
TCR	22	Time constant resistor controlling discharge rate of black and white level capacitor voltages.
BLANK	23	Blanking output, high power push-pull driver.
RED	24	Red output, high power push-pull tri-state driver.
GREEN	25	Green output, high power push-pull tri-state driver.
BLUE	26	Blue output, high power push-pull tri-state driver.
ONH	27	On hours indicator. When high CSO is locked to Video In. When low CSO is not locked.
CSO	28	Generated composite sync output during text, video input is switched through to CSO during modes that contain picture content. See Fig. 6.
VSI	29	Video switch input.
TEST/EVEN	30	Used for factory testing. Even output is enabled by bits IOE and EOE in SYNCsw register. If EVEN output is not used, the pin should be left open-circuit. A 100k Ω pull-down resistor is included.
CAS	31	DRAM column address strobe.
WR	32	DRAM read/not write signal.
HAS	33	DRAM row address strobe.
I ² C SCL	37	I ² C bus serial clock.
I ² C SDA	38	I ² C bus bi-directional data port.
EVENT	39	Active low open drain output interrupt signal to microprocessor.

CRYSTAL SPECIFICATION

Parallel resonant fundamental frequency 27.750000MHz.
AT cut

Tolerance overall $\pm 100\text{ppm}$.
Nominal load capacitance 20pF
Equivalent series resistance $<20\Omega$

A variable capacitor is provided internally on pin XT1 and controlled by a phase locked loop to provide exact trimming of the frequency. This will provide compensation for temperature variation and crystal ageing.

BIT POSITION												
ADDRESS		REGISTER	7	6	5	4	3	2	1	0	R/W	RESET STATE HEX
DEC	HEX											
		RADD	A17	A16	IAI	RA4	RA3	RA2	RA1	RA0	W	00
0	0	ACONA	ACQ	MGC	PBC	PAC	SDC	SCC	SBC	SAC	W	F0
1	1	STORA	STA7	STA6	STA5	STA4	STA3	STA2	STA1	STA0	W	02
2	2	PGS1A	SCS3	SCS2	SCS1	SCS0	SAS3	SAS2	SAS1	SAS0	W	00
3	3	PGS2A	MS2	MS1	MS0	SDS1	SDS0	SBS2	SBS1	SBS0	W	20
4	4	PGS3A	PBS3	PBS2	PBS1	PBS0	PAS3	PAS2	PAS1	PAS0	W	00
5	5	ACONB	HL0	MGC	PBC	PAC	SDC	SCC	SBC	SAC	W	F0
6	6	STORB	STB7	STB6	STB5	STB4	STB3	STB2	STB1	STB0	W	03
7	7	PGS1B	SCS3	SCS2	SCS1	SCS0	SAS3	SAS2	SAS1	SAS0	W	00
8	8	PGS2B	MS2	MS1	MS0	SDS1	SDS0	SBS2	SBS1	SBA0	W	00
9	9	PGS3B	PBS3	PBS2	PBS1	PBS0	PAS3	PAS2	PAS1	PAS0	W	88
10	A	RECON	WI0	WI24	WI25	PIN B	PIN A	FF	CDB	CDA	W	00
11	B	DISCON1	INV	RLH	DSB	CLS	CUR	BLC	LS3	UDI	W	00
12	C	DISCON2	LSO	LS1	LS2	MGS	IHD	SPH	BX1	BX0	W	00
13	D	DISCON3	TXT	MIX	INT	REV	UDK	SPOS	ST2	ST1	W	00
14	E	DISCON4	BXP	BXH	BXT	BXS	DHT	DHB	SG2	SG1	W	00
15	F	HADD	A15	A14	A13	A12	A11	A10	A9	A8	W	00
16	10	LADD	A7	A6	A5	A4	A3	A2	A1	A0	W	00
17	11	WDATA	WD7	WD6	WD5	WD4	WD3	WD2	WD1	WD0	W	00
19	13	SCROLL	WI29	MV	CRL	SRA4	SRA3	SRA2	SRA1	SRA0	W	00
20	14	SYNCSW	ESS	—	—	—	IOE	EOE	SEN	SVS	W	00
0	0	EVENTA	NPR	VHR	830A	X/29	X/28	X/27	X/26	C8	R	—
1	1	EVENTB	NPR	VHR	830B	X/29	X/28	X/27	X/26	C8	R	—
2	2	CBITSA	C14	C13	C12	C11	C10	C7	C6	C5	R	—
3	3	PGR1A	SCR3	SCR2	SCR1	SCR0	SAR3	SAR2	SAR1	SAR0	R	—
4	4	PGR2A	MR2	MR1	MR0	SDR1	SDR0	SBR2	SBR1	SBR0	R	—
5	5	PGR3A	PBR3	PBR2	PBR1	PBR0	PAR3	PAR2	PAR1	PAR0	R	—
6	6	CBITB	C14	C13	C12	C11	C10	C7	C6	C5	R	—
7	7	PGR1B	SCR3	SCR2	SCR1	SCR0	SAR3	SAR2	SAR1	SAR0	R	—
8	8	PGR2B	MR2	MR1	MR0	SDR1	SDR0	SBR2	SBR1	SBR0	R	—
9	9	PGR3B	PBR3	PBR2	PBR1	PBR0	PAR3	PAR2	PAR1	PAR0	R	—
10	A	HAMMC	HC7	HC6	HC5	HC4	HC3	HC2	HC1	HC0	R	FF
17	11	RDATA	RD7	RD6	RD5	RD4	RD3	RD2	RD1	RD0	R	—

Table 2 MV1815 Register details

Note. Write register addresses 18, and 21–31 (12, and 15–1F HEX) are reserved for future development and should not be used.

WRITE REGISTERS

RADD (W)
A16 / A17 Memory quadrant select
IAI Inhibit auto increment
RA\$ Register address (\$=0 to 4)

ACON A/B (W 0 & 5)
ACQ Acquisition on
MGC Magazine compare
PAC Page units compare
PBC Page tens compare
SAC Page subcode compare digit A
SBC Page subcode compare digit B
SCC Page subcode compare digit C
SDC Page subcode compare digit D
RLD Not hold display acquisition circuit

STOR A/B (W 1 & 6)
STA\$ Store number for acquisition A (\$=0 to 7)
STB\$ Store number for acquisition B (\$=0 to 7)

PGS 1/2/3 A/B (W 2,3 4 & 7,8,9)
SAS\$ Subcode digit A (\$=0 to 3) select
SBS\$ Subcode digit B (\$=0 to 2) select
SCS\$ Subcode digit C (\$=0 to 3) select
SDS\$ Subcode digit D (\$=0 or 1) select
PAS\$ Page number (units) (\$=0 to 3) select
PBS\$ Page number (tens) (\$=0 to 3) select
MS\$ Magazine number (\$=0 to 2) select

RECON (W 10)
W10 Write inhibit of packet 0
W124 Write inhibit of packet 24
W125 Write inhibit of packet 25
PIN B Parity check inhibit acquisition circuit B
PIN A Parity check inhibit acquisition circuit A
FF Full field Teletext
CDB Clear store disable acquisition circuit B
CDA Clear store disable acquisition circuit A

DISCON1 (W 11)
INV Invert display
RLH Roll headers
DSB Display acquisition circuit B (A if zero)
CLS Clear current display store
CUR Cursor enable
BLC Block cursor
LS3 Language group select
UDI Display update indicator

DISCON2 (W 12)
LS\$ Language select (\$=0 to 2)
MGS Magazine serial
IHD Inhibit display, rows 2 to 26 disabled
SPH Suppress header
BX\$ Box control bits (\$=0 or 1)

DISCON3 (W 13)
TXT Text / not picture
MIX Mix text and picture
INT Display text in interface mode (see Figure 6)
REV Reveal hidden text
UDK Update key, rows 1 to 26 disabled.
SPOS Status line position
ST2 Display Status line 2 (row 26)
ST1 Display Status line 1 (row 25)

WRITE REGISTERS

DISCON4 (W 14)
BXP Box page number
BXH Box header
BXT Box time
BXS Box status rows
DHT Double height top half
DHB Double height bottom half
SG\$ Separate graphics control bits (\$=0 or 1)

HADD and LADD (W 15 & 14)
A\$ Memory address (\$=0 to 15)

WDATA (W 17)
WD\$ Data to be written to memory (\$=0 to 7)

SCROLL (W 19)
W129 Write inhibit of packet 29
MV Majority vote on framing code
CRL Cursor lock at last HADD, LADD setting
SRA\$ Scroll display row up (\$=0 to 4)

SYNCSW (W 20)
ESS External sync source
IOE Internal output enable
EOE Even output enable
SEN Select enable – SVS bit
SVS Select VSI as sync source

READ REGISTER

EVENT A/B (R 0 & 1)
NPR New page received
VHR Valid header received
830\$ Packet 30 received acquisition \$ (\$=A or B)
X/29 Packet 29 received
X/28 Packet 28 received
X/27 Packet 27 received
X/26 Packet 26 received
C8 Update Indicator

CBITS A/B (R 2 & 6)
C14 Language select bit
C13 Language select bit
C12 Language select bit
C11 Magazine serial
C10 Inhibit display
C7 Suppress header
C6 Sub-title
C5 Newsflash

PGR1/2/3/A/B (R 3,4,5 & 7,8,9)
SAR\$ Subcode digit A (\$=0 to 3) received
SBR\$ Subcode digit B (\$=0 to 2) received
SCR\$ Subcode digit C (\$=0 to 3) received
SDR\$ Subcode digit D (\$=0 or 1) received
PAR\$ Page number (units) (\$=0 to 3) received
PBR\$ Page number (tens) (\$=0 to 3) received
MR\$ Magazine number (\$=0 to 2) received

HAMMC (R 10)
HC\$ Hamming error counter (\$=0 to 7)

RDATA (R 17)
RD\$ Data read from memory (\$=0 to 7)

I²C BUS

Device Address

0010 001 R/W

The circuit works as a slave transmitter with bit eight set high or as a slave receiver with bit eight low. In receive mode, the first data byte is written to the RADD register, where the least significant five bits form the sub-address for the next register to be written. The most significant three bits of RADD are data bits, see Table 2.

Automatic incrementing of registers allows successive data bytes to be written to or read from the registers. The automatic incrementing can be disabled by setting bit 5 of the sub-address register (RADD) to one.

If the sub-address is set to write or read from DRAM, the auto incrementing allows access to successive bytes of data. All DRAM addresses may be accessed via the I²C bus register. A stop condition resets the sub-address to zero.

Example of I²C Bus Messages

Write operation – MV1815 as a slave receiver

S	MV1815 ADD	W	A*	RADD (n)	A*	DATA (reg n)	A*	DATA (reg n + 1)	A*	P
---	---------------	---	----	-------------	----	-----------------	----	---------------------	----	---

S Start Conditions
P Stop Condition
A Acknowledge
NA No Acknowledge
W Write (=0)
R Read (=1)
* MV1815 output

Read operation – MV1815 as a slave transmitter

S	MV1815 ADD	R	A*	DATA* (reg 0)	A	DATA* (reg 1)	A	DATA* (reg 2)	NA	P
---	---------------	---	----	------------------	---	------------------	---	------------------	----	---

Write/read operation – MV1815 as a slave transmitter sending data from register n etc.

S	MV1815 ADD	W	A*	RADD (reg n)	A*	S	MV1815 ADD	R	A*	DATA* (reg n)	A	DATA* (reg n + 1)	NA	P
---	---------------	---	----	-----------------	----	---	---------------	---	----	------------------	---	----------------------	----	---

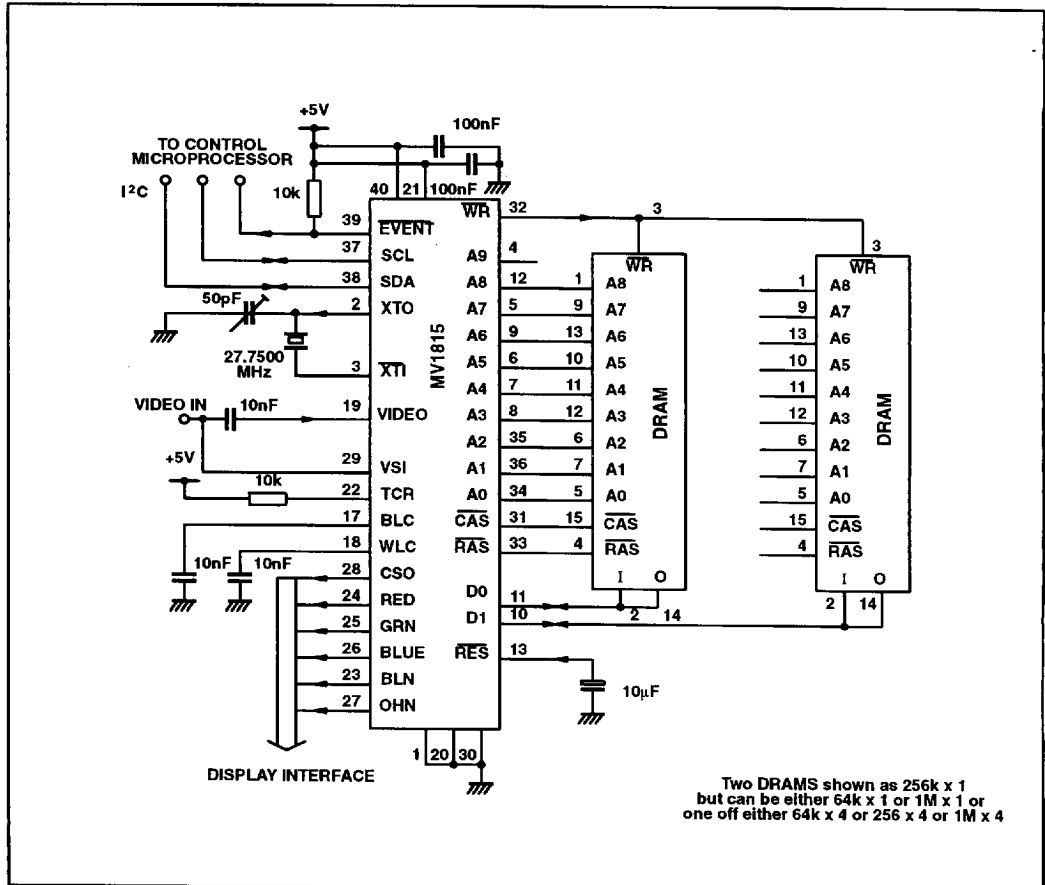


Fig. 3. MV1815 Typical application

MV1815

DRAM Memory Organisation

The DRAM as viewed from the I²C Bus is organised in 1024 byte blocks. Each 1024 bytes (400 HEX) block is referred to as a store. Stores 0 and 1 are reserved for the non-display packets from acquisition A and B respectively. Stores 2 and above are used for display pages, one page per store.

The display page number, first 8 bytes on row 0, are held in Store 0 bytes 0 to 7. The Time display, last 8 bytes on row 0 are also held in store 0 bytes 8 to F (HEX). See Figs. 4 and Figs. 5

To calculate the values of the start address in RADD, HADD and LADD for any store simply multiply the store number (HEX) by 400 (HEX)

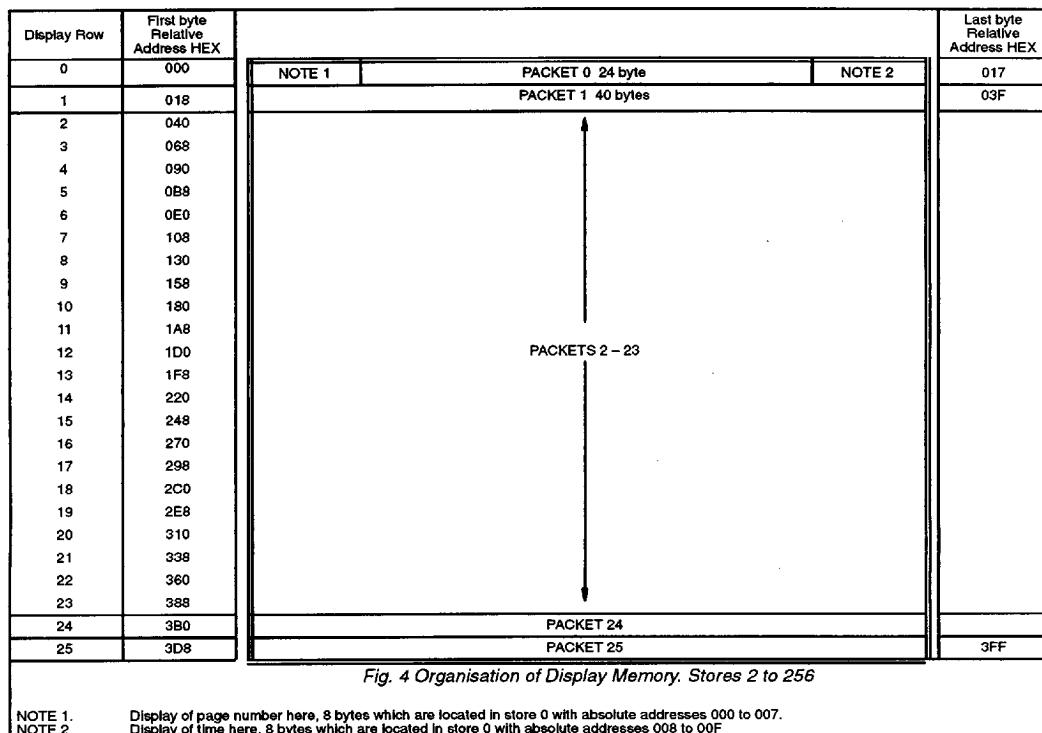
e.g. Decimal store 160 = A0
 $A0 \times 400 = 2 \quad 80 \quad 00 \text{ (HEX)}$
 RADD HADD LADD

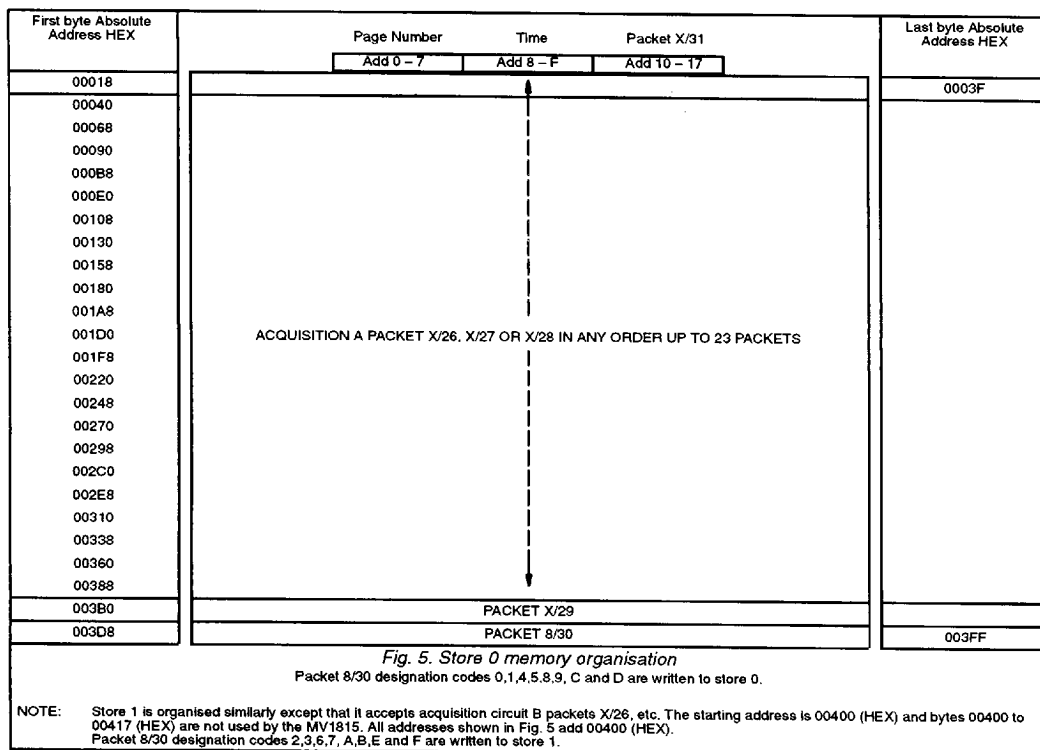
To find the address of any particular location in the store add the value of the relative address from Fig. 4 or 5.

Table 3 gives examples of the start addresses of stores expressed as values of A17, A16 from RADD, A15-A8 from HADD and A7-A0 from LADD.

STORE NUMBER HEX	START ADDRESS IN HEX		
	RADD	HADD	LADD
00	0	00	00
01	0	04	00
02	0	08	00
03	0	0C	00
04	0	10	00
05	0	14	00
06	0	18	00
07	0	1C	00
08	0	20	00
:	:	:	:
0F	0	3C	00
10	0	40	00
:	:	:	:
40	1	00	00
41	1	04	00
:	:	:	:
7F	1	FC	00
80	2	00	00
:	:	:	:
F0	3	C0	00
:	:	:	:
FF	3	FC	00

Table 3





	0	1
0	Alpha Black	Graphic Black
1	Alpha Red	Graphic Red
2	Alpha Green	Graphic Green
3	Alpha Yellow	Graphic Yellow
4	Alpha Blue	Graphic Blue
5	Alpha Magenta	Graphic Magenta
6	Alpha Cyan	Graphic Cyan
7	Alpha White ¹	Graphic White
8	Flash	Conceal Display ²
9	Steady ¹	Contiguous Graphics ^{1 2}
A	End Box ¹	Separated Graphics ²
B	Start Box ³	No action
C	Normal Height ^{1 2}	Black Background ^{1 2}
D	Double Height	New Background ²
E	No action	Hold Graphics
F	No action	Release Graphics ¹

Table 4 Control codes

- Notes: 1. Presumed set at the start of each display row.
 2. Action "set at the current space", others are "set after the current space".
 3. Two consecutive codes are transmitted, action takes place between them.

■ 3768522 0027415 33T ■

LS(3210)	0000	0001	0010	0011	0100	0101	0110	0111
TABLE POSITION	ENGLISH	GERMAN	SWEDISH FINNISH	ITALIAN	FRENCH (BELGIAN)	SPANISH	CZECH	ENGLISH
2/3	£	#	#	£	é	ç	#	£
2/4	\$	\$	¤	\$	ï	\$	û	\$
4/0	@	§	€	é	à	i	č	@
5/B	←	Ä	Ä	°	è	á	ě	←
5/C	½	Ö	Ö	ç	ê	é	ž	½
5/D	→	Ü	Ä	→	ù	í	ý	→
5/E	↑	^	Ü	↑	î	ó	í	↑
5/F	#	□	□	#	#	ú	ř	#
6/0	▢	°	é	ù	è	ì	é	▢
7/B	¼	ä	ä	à	â	ü	á	¼
7/C	⅓	ö	ö	ò	ô	ñ	ě	⅓
7/D	¾	ü	ä	è	û	è	ú	¾
7/E	÷	ß	ü	ì	ç	à	š	÷

LS(3210)	1000	1001	1010	1011	1100	1101	1110	1111
TABLE POSITION	POLISH	ROMANIAN	HUNGARIAN	TURKISH	DANISH	SERBO CROAT	ASCII	SOUTH AFRICAN
2/3	#	#	#	TL	£	#	#	£
2/4	ń	¤	ú	ğ	\$	\$	\$	\$
4/0	q	T	É	İ	@	Č	@	h
5/B	Z	Â	í	Ş	Æ	Ć	[	ë
5/C	ś	Ş	Ö	Ö	Ø	Ž	\	è
5/D	Ł	Ă	Á	Ç	Å	Đ	]	ü
5/E	ć	Î	Ú	Ü	↑	Š	^	é
5/F	ó	ı	ö	Ğ	#	ë	□	ı
6/0	ę	ţ	é	ı	▢	č	,	š
7/B	ż	ă	ó	ş	æ	ć	f	ä
7/C	ś	ş	ö	ö	ø	ž	▢	ô
7/D	ż	ă	á	ç	å	đ	}	û
7/E	ż	î	ü	ü	÷	š	~	ö

Table 5. Western European national optional variations - MV1815-2.

R O W	COLUMN (bits 4, 5, 6, & 7)																	
	2	2a	3	3a	4	5	6	6a	7	7a	8	9	A	B	C	D	E	F
0			0		P			p		À	æ	è	ó	š	ô			
1	!		1		A	Q	a		q		Ā	č	ǵ	ò	š	ú		
2	”		2		B	R	b		r		Ā	č	í	ð	ś	ý	\	£
3			3		C	S	c		s		Ā	č	í	ö	š	ž	J	\$
4			4		D	T	d		t		Ā	č	í	č	š	z	^	@
5	%		5		E	U	e		u		Ā	č	í	ø	β	ž	'	←
6	&		6		F	V	f		v		Ā	č	í	ó	Ť	ž	£	1 ₂
7	'		7		G	W	g		w		Æ	Đ	í	ó	č	ž		→
8	(		8		H	X	h		x		á	đ	í	ó	č	ž	}	↑
9	)		9		I	Y	i		y		ā	é	í	ó	ú	ó	~	#
A	*		:		J	Z	j		z		ā	é	č	ó	ú	š	€	
B	+		:		K		k				ā	é	č	ó	ú	·	≡	1 ₄
C	,		<		L		l				ā	é	č	ó	ú	°	⊗	
D	-		=		M		m				ā	é	č	ó	ú	⊗	⊗	3 ₄
E	.		>		N		n				ā	é	č	ó	ú	í	⊗	÷
F	/		?		O		o				ā	é	č	ó	ú	č	⊗	

Table 6. Character ROM contents as viewed by the display - MV1815-2.

Notes: Character positions F0 and F1 will be displayed as spaces, but are actually spacing control codes, like the control columns 0 and 1 listed in table 10.

F0 is UNDERLINE start / stop code.

F1 is INVERT display colours start / stop code.

FF is displayed as all foreground.

□ Characters in these positions are displayed according to the setting of LS(0-3) bits, see table 5.

When graphics mode is set, columns 2a, 3a, 6a & 7a are displayed as the graphic symbols shown. All other columns are displayed normally. The graphic symbols are shown above with a border which is not present when the symbol is displayed on the screen.

ELECTRICAL CHARACTERISTICS

$T_{amb} = 0^{\circ}\text{C}$ to $+70^{\circ}\text{C}$, $V_{CC} = +5\text{V}$ to $\pm 10\%$. These characteristics are guaranteed by either production test or design. They apply within the specified ambient temperature and supply voltage ranges unless otherwise stated.

Characteristics	Pin	Value			Units	Conditions
		Min	Typ	Max		
Supply Voltage	21 & 40	4.5	5.0	5.5	V	X _{TI} =27.75MHz All outputs open
Supply Current	21 & 40		25		mA	circuit
	21 & 40		15		mA	X _{TI} =0Hz All outputs open circuit
Video Input, VSI	19 & 29					
Voltage Amplitude		0.8		3.0	V _{pp}	Bottom of Sync to White (pk-pk)
Source Impedance				250	Ω	
TCR Input	22					
External Resistance		5	10	200	k Ω	Connected to V _{DD}
BLC and WLC	17 & 18					
Capacitor Value			10		nF	Connected to GND
Capacitor Tolerance		-10		+10		
Effective Series Resistance				5	Ω	1MHz
Sync I/O	14					
Output voltage Low			0.2	0.4	V	100K (nom) pull up resistor I _{OL} =2.4mA
Input voltage Low		0		1.0	V	
Input voltage High		V _{DD} -1.0		V _{DD}	V	
Input Current Low		-22	-50	-220	μA	V _{IN} =V _{SS}
Input Current High		-30		+30	μA	V _{IN} =V _{DD}
Data I/O	15					
Output voltage High		2.4	4.5		V	No pull-up resistor I _{OH} =-1.2mA
Output voltage Low			0.2	0.4	V	I _{OL} =2.4mA
Input voltage Low		0		1.0	V	
Input Voltage High		V _{DD} -1.0		V _{DD}	V	
Input current	-30		+30		μA	V _{IN} =V _{DD} or V _{SS}
EXT/INT (Note 1)	16					
Input current Low		-10		+10	μA	100k Ω (nom) pull-down resistor V _{IN} =V _{SS}
Input current High		22	50	220	μA	V _{IN} =V _{DD}
X_{TI} (Note 1)	3					
Input current Low		-5.0	-5.0	-20	μA	1M (nom) resistor to X _{TO} -0.3 < V _{IN} < V _{IL} max
Input current High		0.5	5.0	20	μA	V _{IH} min < V _{IN} < (V _{DD} +0.3)
X_{TO} output	2					
Output voltage High		V _{DD} -1.0	4.5		V	See note 2 I _{OH} =-1.0mA
Output voltage Low			0.2	0.4	V	I _{OL} =2.0mA
Frequency			27.750		MHz	$\pm 100\text{ppm}$

Notes.

1. Input voltage low and input voltage high for these are as specified for Data I/O
2. When RESET is held low, A9 (pin 4) will output F_{OSC}/2. If required, adjust capacitor on X_{TO} for a frequency of 13.875MHz.

ELECTRICAL CHARACTERISTICS (continued)

$T_{amb} = 0^{\circ}\text{C}$ to $+70^{\circ}\text{C}$, $V_{CC} = +5\text{V}$ to $\pm 10\%$. These characteristics are guaranteed by either production test or design. They apply within the specified ambient temperature and supply voltage ranges unless otherwise stated.

Characteristics	Pin	Value			Units	Conditions
		Min	Typ	Max		
ON HOUR INDICATOR ONH	27					
Output voltage V_{OH}		$V_{DD}-1.0$	4.5		V	$I_{OH} = -1.2\text{mA}$
Output voltage V_{OL}			0.2	0.4	V	$I_{OL} = 2.4\text{mA}$
I²C bus SCL, SDA I/Ps	37, 38					100k Ω (nom) pull-up resistor
Input voltage Low		0		1.5	V	
Input voltage High		3.5		V_{DD}	V	
Output voltage Low		0	0.1	0.40	V	$I_{OL} = 3\text{mA}$
SCL clock frequency	37		100	1000	kHz	
RED, GREEN, BLUE	24, 25, 26					
Output voltage High		$V_{DD}-1.0$	4.5		V	$I_{OH} = -12.0\text{mA}$
Output voltage Low			0.2	0.4	V	$I_{OL} = 24.0\text{mA}$
Tri-state output leakage current		-60		60	μA	$V_{OH} = V_{SS}$ or V_{DD}
EVENT	39					100k Ω (nom) pull-up resistor
Output voltage Low			0.2	0.4	V	$I_{OL} = 2.4\text{mA}$
BLANK	23					
Output voltage High		$V_{DD}-1.0$	4.5		V	$I_{OH} = -12.0\text{mA}$
Output voltage Low			0.2	0.4	V	$I_{OL} = 24.0\text{mA}$
CSO	28					With typical load of 360 Ω
Output voltage swing			0.5		V _{pp}	Text mode only, see note 3
Output voltage High		$V_{DD}-0.5$			V	Load of 4.3k Ω to V_{DD}
Output voltage Low				$V_{DD}+0.5$	V	
TEST/EVEN	30					100k Ω (nom) pull-down resistor
Output voltage High		$V_{DD}-1.0$	4.5		V	$I_{OH} = -1.2\text{mA}$
Output voltage Low			0.2	0.4	V	$I_{OL} = 2.4\text{mA}$
Input voltage Low		0		1.0	V	
Input voltage High		$V_{DD}-1.0$		V_{DD}	V	
Input current Low		-30		+30	μA	$V_{IN} = V_{SS}$
Input current High		22	50	220	μA	$V_{IN} = V_{DD}$

Note 3.

CSO output voltage when in picture or mix mode will depend on size of Video signal applied to VSI pin 29, together with attenuation due to internal transmission switch (60 Ω nom) and external load on pin 28. In these states the video signal at pin 29 is switched straight through to pin 28.

ELECTRICAL CHARACTERISTICS

T_{amb} = 0°C to +70°C, V_{CC} = +5V to $\pm 10\%$. These characteristics are guaranteed by either production test or design. They apply within the specified ambient temperature and supply voltage ranges unless otherwise stated.

Characteristics	Pin	Value			Units	Conditions
		Min	Typ	Max		
MEMORY INTERFACE						
DATA D0,D1	11,10					100k Ω (nom) pull-up resistor
Output voltage High		$V_{DD}-1.0$	4.5		V	$I_{OH}=-1.2mA$
Output voltage Low			0.2	0.4	V	$I_{OL}=2.4mA$
Input voltage Low		0		1.0	V	
Input voltage High		$V_{DD}-1.0$		V_{DD}	V	
Input current Low		-22	-50	-220	μA	$V_{IN}=V_{SS}$
Input current High		-30		+30	μA	$V_{IN}=V_{DD}$
ADDRESS A0-A9 RAS, CAS, WR	See Fig. 1					
Output voltage High		$V_{DD}-1.0$	4.5		V	$I_{OH}=-1.2mA$
Output voltage Low			0.2	0.4	V	$I_{OL}=2.4mA$
RESET (Schmitt Input)	13					100k Ω (nom) pull-up resistor
Input voltage Low		0		1.0	V	
Input voltage High		$V_{DD}-1.0$		V_{DD}	V	
Input current Low		-22	-50	-220	μA	$V_{IN}=V_{SS}$
Input current High		-10		+10	μA	$V_{IN}=V_{DD}$
Hysteresis voltage			0.8		V	(Rising threshold) – (falling threshold) voltages

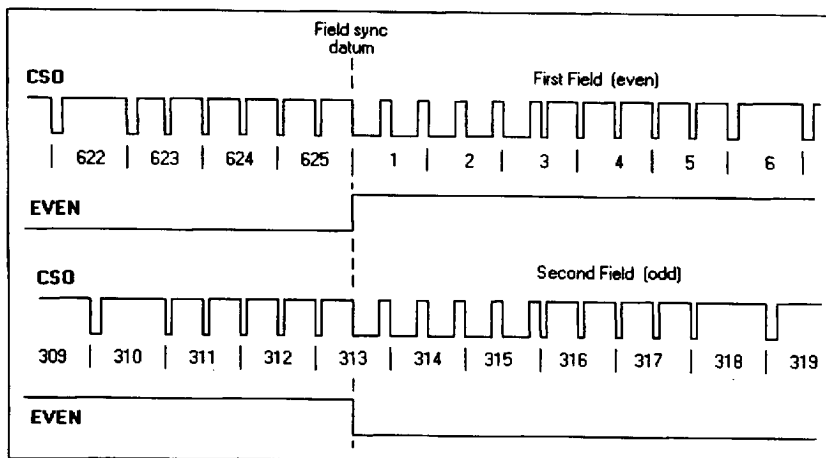


Fig. 6a. Composite sync output (interlaced) and EVEN output.

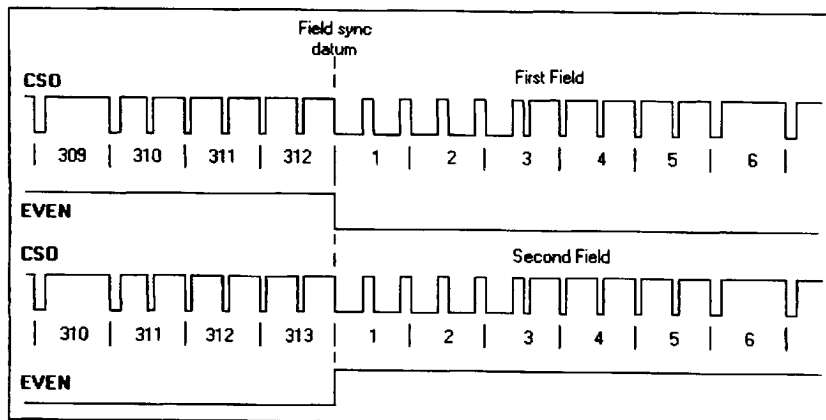


Fig. 6b. Composite sync output (non-interlaced) and EVEN output.

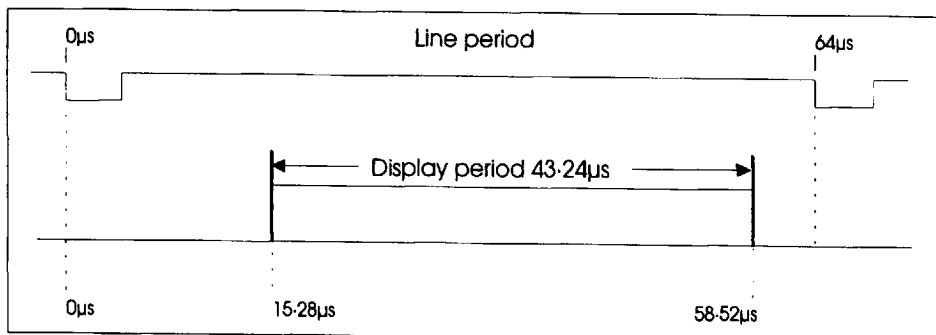


Fig. 7. Timing of display for RGB outputs related to composite sync output.