

## Introducing the “Australian” Timings

The timings, currently being used to drive high-definition televisions, are largely based on industry standard professional broadcast studio formats (such as ITU-R BT.601-5, ITU-R BT.709-5, ITU-R BT.1358-98, SMPTE 274M-1998, SMPTE 295M-1997, and SMPTE 296M-2001). When used to drive 50Hz consumer CRT-based displays, these timings require four different line rates and three different blanking ratios to be accepted (as summarized in Table 1).

**Table 1 Modern “Professional” Display Timings**

Format Name(s)	Active Pixels	Active Lines	Total Pixels	Total Lines	Line Blank (%)	Fields	Frame Rate (Hz)	Line Rate (KHz)	Pixel Rate (MHz)
576i	720	576	864	625	20	2	25	15.625	13.500
576p50	720	576	864	625	20	1	50	31.250	27.000
720p50	1280	720	1650	750	28.91	1	50	37.500	74.250
1080i25, 1080s25	1920	1080	2640	1125	37.50	2	25	28.125	74.250

CRT-based displays typically have difficulty making glitchless transitions and maintaining centering when presented with varying line rates and blanking ratios.

Recently, Standards Australia has floated a draft revision (AS 4933.1—200X version 5-A dated November 2002) of a standard (first published as AS 4933.1—2000), which includes a new set of formats that reduce the number of line rate & blanking ratio combinations to one. In this new scheme, a set-top-box (STB) receives and decompresses incoming “professionally” timed content and scan converts it to one of two alternate frame timings; namely, 625-lines @ 50 frames/sec or 1250-lines @ 25 frames/sec. Both of these output frame timings share a common line rate and blanking ratio. With line rate and blanking ratio now fixed, glitches and centering problems are completely eliminated. Figures 1 & 2 illustrate the various scan conversions that are involved.

## Library Formats

Our new format library now includes all of the timings that you will need to test your displays for compatibility with the proposed timings, which are listed in Table 2.

**Table 2 Original “Legacy” Australian Timings**

Format Name(s)	Content Pixels	Content Lines	Active Pixels	Active Lines	Total Pixels	Total Lines	Line Blank (%)	Fields	Frame Rate (Hz)	Line Rate (KHz)	Pixel Rate (MHz)
576i50WL	720	576	720	576	1152	625	20	2	50	31.250	36.000
576i50WH	960	576	960	576	1152	625	20	2	50	31.250	36.000
576pWL	720	576	720	576	1152	625	20	1	50	31.250	36.000
576pWH	960	576	960	576	1152	625	20	1	50	31.250	36.000
1152iLA	720	576	720	1152	1152	1250	20	2	25	31.250	36.000
1152iSH	1280	720	1280	1152	1536	1250	20	2	25	31.250	48.000
1152iLH	1920	1080	1920	1080	2304	1250	20	2	25	31.250	72.000

Our new library also includes an alternate set of non-proprietary Australian-compatible timings (see Table 3), whose line parameters have been “SMPTE-tuned”. The formats in this set have been adjusted slightly, from the original draft timings of AS 4933.1-200X, so as to follow the latest ITU\_R BT.709-5 recommendations regarding pixel rate.

**Table 3 Modern "SMPTE-tuned" Australian Timings**

Format Name(s)	Content Pixels	Content Lines	Active Pixels	Active Lines	Total Pixels	Total Lines	Line Blank (%)	Fields	Frame Rate (Hz)	Line Rate (KHz)	Pixel Rate (MHz)
576i50_L	720	576	720	576	1188	625	23.75	2	50	31.250	37.125
576i50_H	960	576	960	576	1188	625	23.75	2	50	31.250	37.125
576pWL_	720	576	720	576	1188	625	23.75	1	50	31.250	37.125
576pWH_	960	576	960	576	1188	625	23.75	1	50	31.250	37.125
1152iLA_	720	576	720	1152	1188	1250	23.75	2	25	31.250	37.125
1152iSH_	1280	720	1280	1152	1584	1250	23.75	2	25	31.250	49.500
1152iLH_	1920	1080	1920	1080	2376	1250	23.75	2	25	31.250	74.250

Modern television signals (i.e. those described in Part 2 of ITU-R BT.709-5) are harmonically related to 148.5MHz, whereas legacy signals (i.e. those described in Part 1 of ITU-R BT.709-5) are not - they are instead tuned to 144MHz. 148.5MHz and 144MHz are harmonics of 4.752GHz, which is out of the range of ordinary digital logic. Therefore, both sets of pixel frequencies cannot be easily derived from a common fixed clock source, without resorting to PLL technology. ITU-R BT.709-5 recommends, "...for new HDTV programme production and international exchange, systems described in Part 2 are preferred". In other words, formats based on 148.5MHz are now preferred. The timings in the alternate Australian set, provided in our new library, are all harmonically tuned to 148.5MHz in keeping with Part 2 of ITU-R BT.709-5. In order to allow formats from the modern and legacy sets to be distinguished, the names of the modern "SMPTE-tuned" timings have underlines in them. Figures 3 & 4 show the equivalent "SMPTE-tuned" mappings that might be provided by a STB.

### STB Received Format Versus CRT Display Interconnect Format

To summarize, formats received (over the air) by a STB can be mapped to alternate CRT interconnect formats in order to keep horizontal timing glitch-free and centered. Table 4 lists some important cases. This table assumes that the physical screen of the display has a 16:9 aspect ratio.

**Table 4 STB Received Formats Versus CRT Interconnect Formats**

STB Received Format Name(s)	STB Scan Conversion	CRT Interconnect Legacy Signal Format		CRT Interconnect Modern "SMPTE-tuned" Signal Format	
		Long Name	Short Name	Long Name	Short Name
576i	Double Field Rate & Letterbox	576i50WHLA	576i50WL	576i50WHLA_	576i50_L
	2/1 Vertical Scope & Letterbox	1152iLSA	1152iLA	1152iLSA_	1152iLA_
576p	Letterbox	576pWHLA	576pWL	576pWHLA_	576pWL_
720p50	4/5 Vertical Scope 720 to 576-lines	576pWH	576pWH	576pWH_	576pWH_
	8/5 Vertical Scope 720 to 1152-lines	1152iSH	1152iSH	1152iSH_	1152iSH_
1080i25, 1080s25	Pixel /Line Halved & Letterbox	576i50WH	576i50WH	576i50WH_	576i50_H
	Letterbox	1152iLH	1152iLH	1152iLH_	1152iLH_

### New Sync Types

The new Australian timings utilize two new sync types: composite type 5 and separate type 6. Composite type 5 can be used to specify Australian analog composite sync (ACS) and digital composite sync (DCS) via ASCT and DSCT parameters, respectively. In addition, separate sync type 6 can be used to specify Australian digital separate sync (DSS) via the DSST parameter.

## Special Even-Total Interlace

The high-definition (HD) timings, of the AS 4933.1—200X draft standard, are loosely based on selected timings from the SMPTE 295M-1997, ITU-R BT.1358-98, and ITU-R BT.709-5 (Section 5 1250/50/2:1 system) standards. In the case of the 1152-line timings, a system almost identical to the 1250/50/2:1 system - described in the SMPTE 295M-1997 & ITU-R BT.709-5 standards - is used. This system utilizes a special interlacing technique that requires the display to have special vertical deflection circuitry. All of the 1152i formats have an even number of total lines per frame ( $625 \times 2 = 1250$ ), which does not provide for a naturally interlaced scanning raster. The frame must be electronically split in two unequal fields (624.5 and 625.5 lines) and a special DC-coupled vertical raster deflection circuit used. If not present, the two interlaced fields will be perfectly paired and will lay directly on top of each other – resulting in a distorted and under sampled 625-line picture.

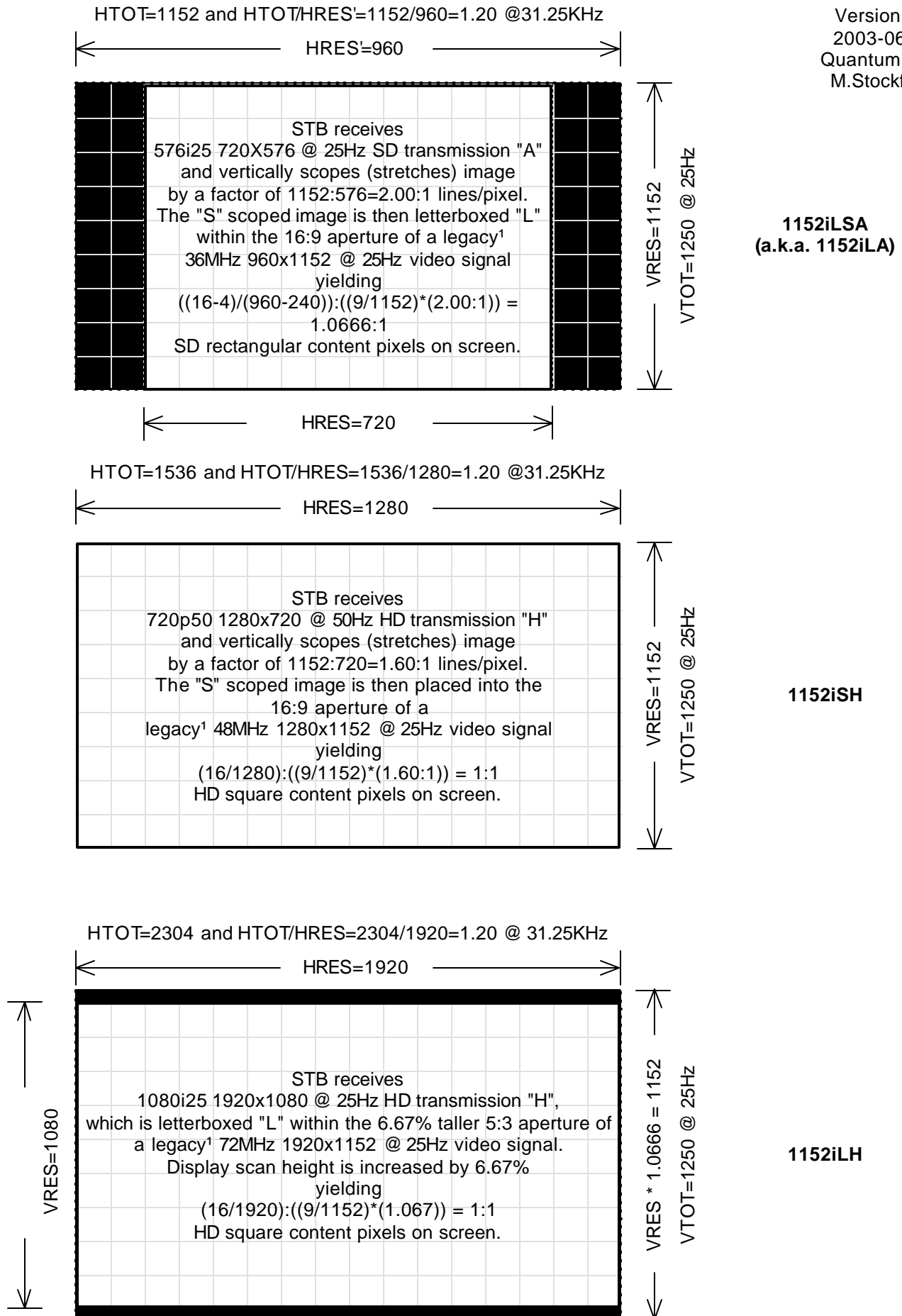
## Zoom Logic

Australian-compatible displays are required to apply a 6.7% vertical zoom, in order to fill the screen and square the pixels, whenever the (1080-letterboxed-in-1152) formats 1152iLH & 1152iLH\_ are present. The presence of these formats can be detected as follows:

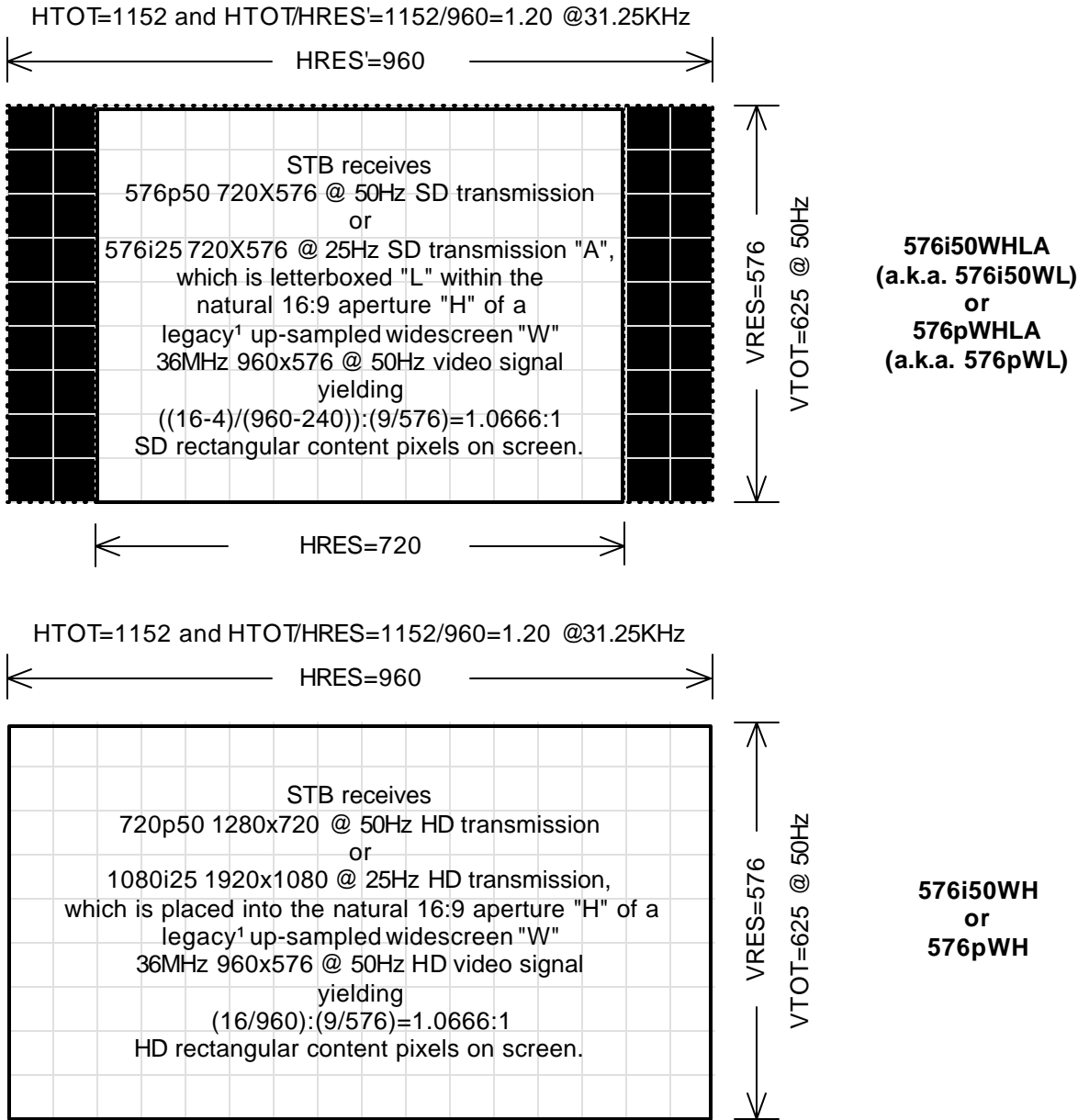
1. In the case of digital or analog composite sync (ACS or DCS), 1152iLH & 1152iLH\_ can be detected by the presence of a very short  $\frac{1}{2}$ -line vertical sync pulse width. In all of the other cases (i.e. 576i50WL, 576i50WL\_, 576pWL, 576pWL\_, 576pWH, 576pWH\_, 1152iLA, 1152iLA\_, 1152iSH, 1152iSH\_, and 576i50), the vertical sync pulse width is 5-lines, so that the two modes can be easily distinguished via suitable low-pass filter and pulse dropout detector.
2. In the case of digital separate sync (DSS), the presence 1152iLH & 1152iLH\_ can be detected by comparing horizontal and vertical sync polarity. The horizontal and vertical sync polarities will be opposite whenever either of these formats (1152iLH & 1152iLH\_) is present, while the polarities will be the same in the other cases (i.e. 576i50WL, 576i50\_L, 576i50WH, 576i50\_H, 576pWL, 576pWL\_, 576pWH, 576pWH\_, 1152iLA, 1152iLA\_, 1152iSH, and 1152iSH\_). In both cases, the vertical sync width remains at 5-lines.

## Vertical Sync Pulse Width Special Case

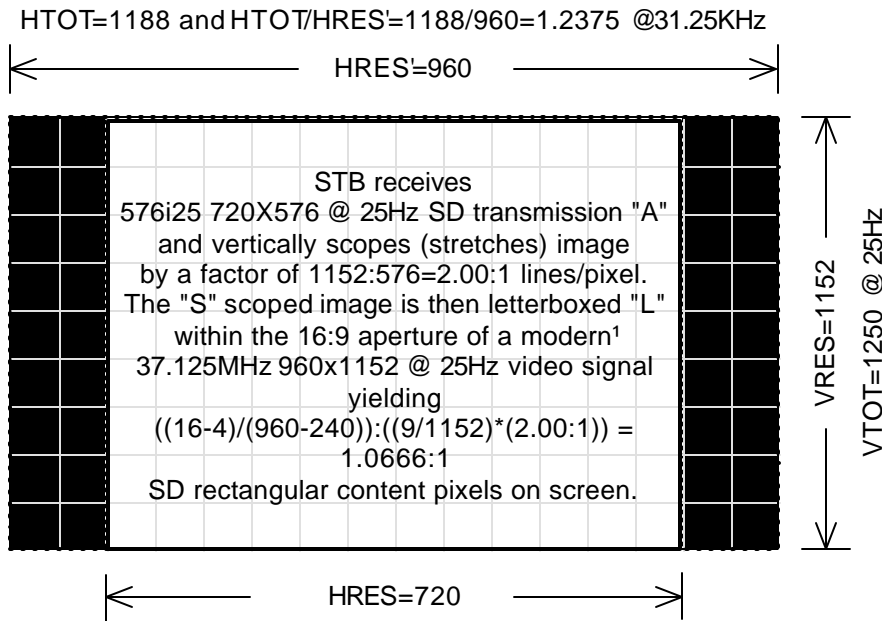
Whenever the 1152iLH & 1152iLH\_ formats are present, you will note that the width of the vertical sync pulse is automatically switched from  $\frac{1}{2}$ -line to 5-lines in response to a change from either composite sync type (ACS or DCS) to separate (DSS) sync, respectively. Normally, this sort of change would require two separate formats – one for composite sync and one for digital sync – and would force you to switch formats instead of just sync types via the usual ACS, DCS, or DSS keys or SSST parameter sync selection controls. In order to avoid this complication, we have added special logic, in the case of composite sync type number 5, that causes the composite vertical sync pulse width to be automatically shortened to  $\frac{1}{2}$ -line, whenever a composite sync type is selected and the horizontal (HSPP) and vertical (VSPP) sync pulse polarities of the format are opposite.



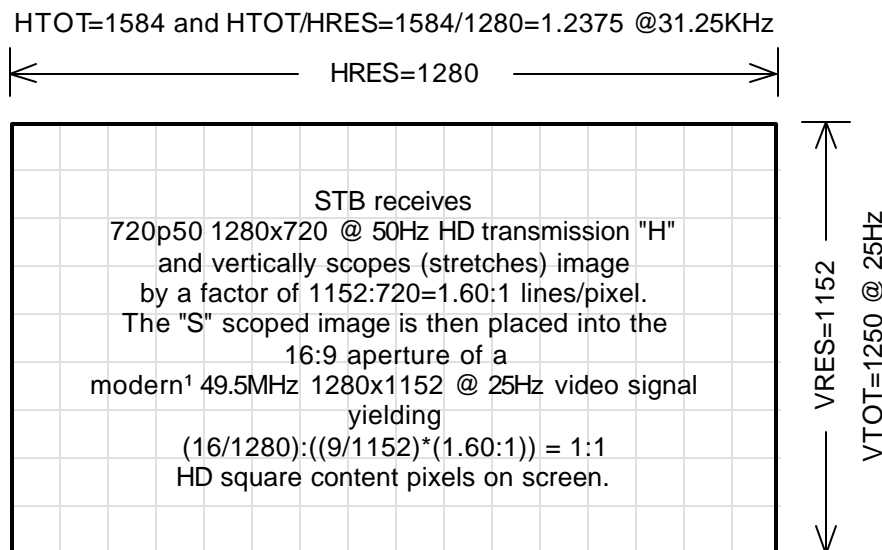
**Figure 1 Australian Interlaced 25 Frames/second 16:9 Rasters**



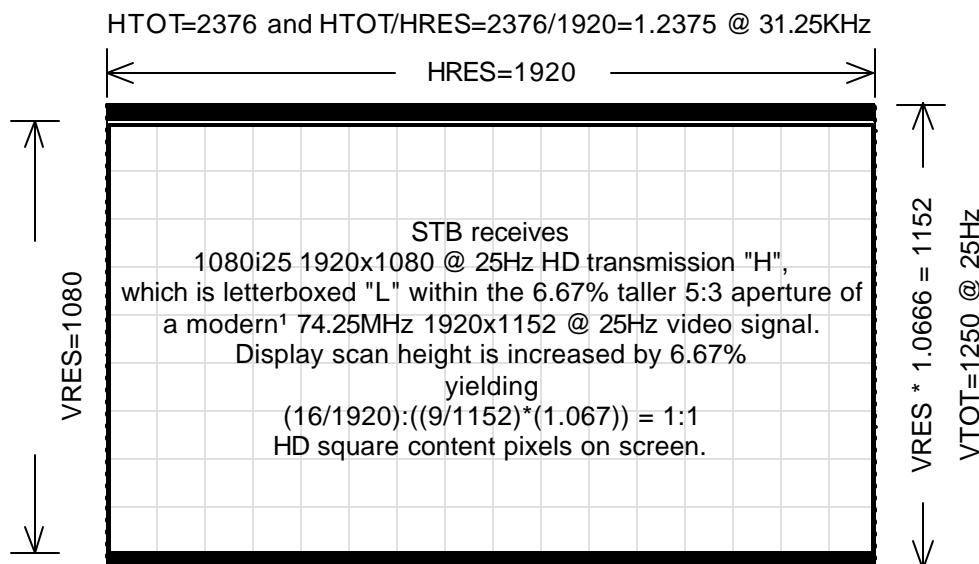
**Figure 2 Australian Progressive 50 Frames/second 16:9 Rasters**



**1152iLSA\_**  
 (a.k.a. 1152iLA\_)



**1152iSH\_**



**1152iLH\_**

**Figure 3 SMPTE-tuned Australian Interlaced 25 Frames/second 16:9 Rasters**

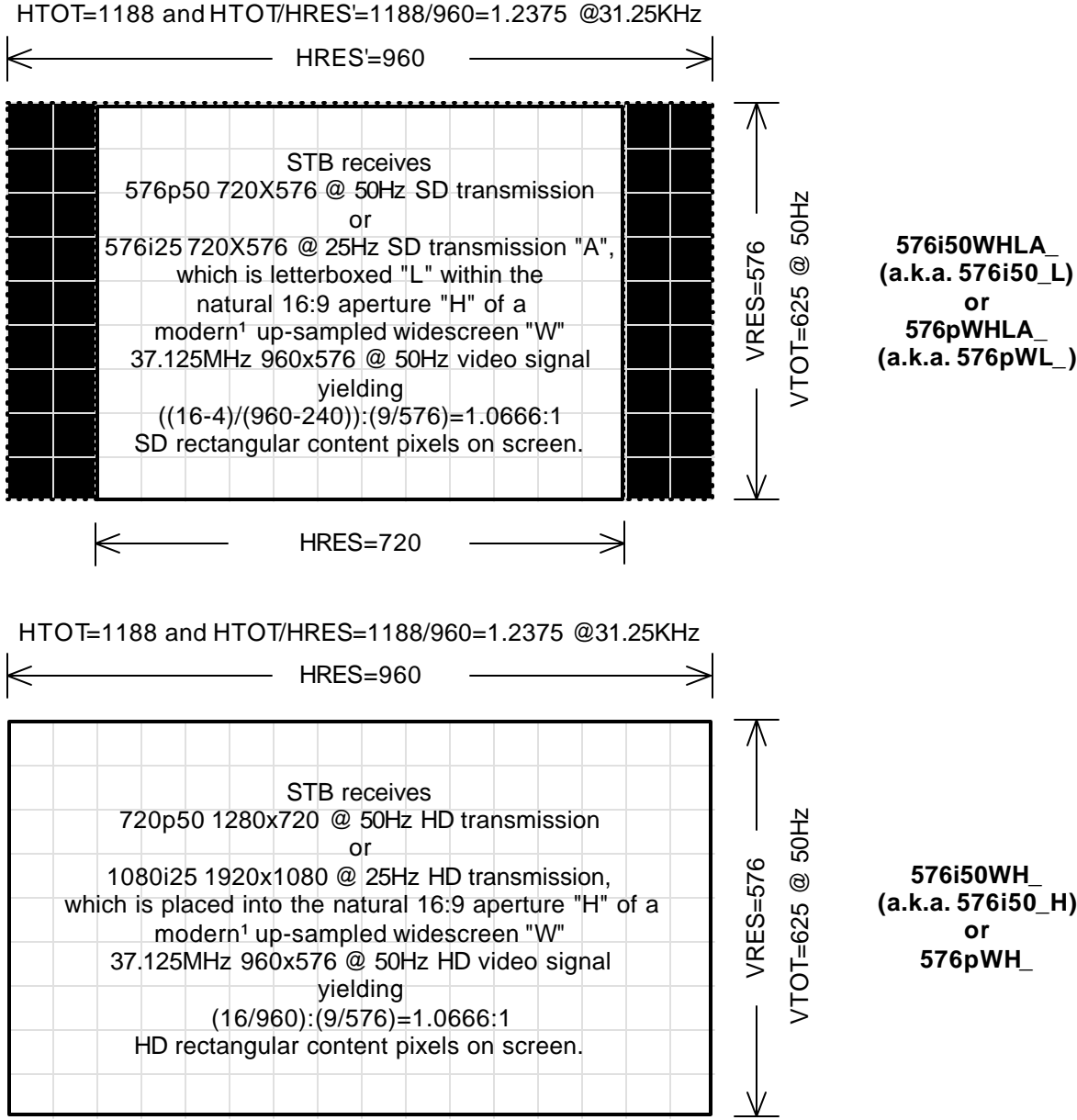


Figure 4 SMPTE-tuned Australian Progressive 50 Frames/second 16:9 Rasters

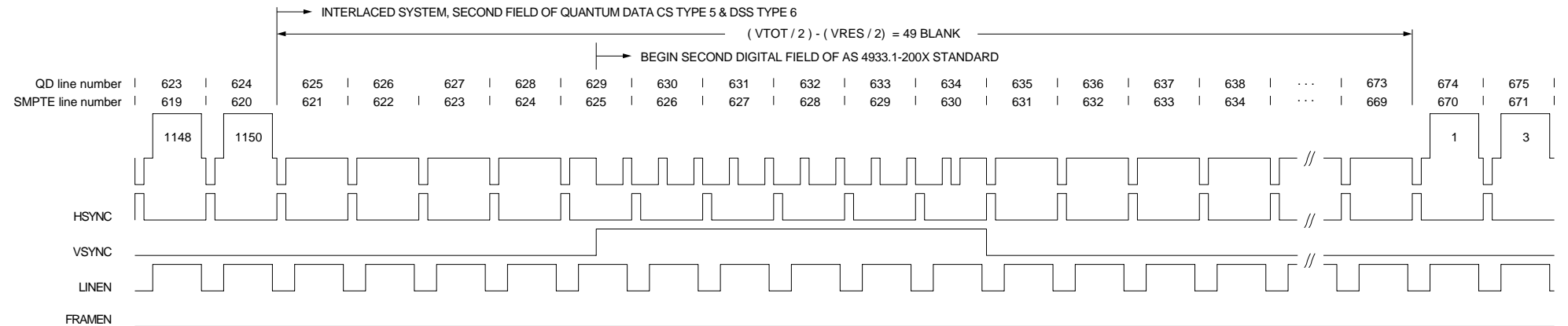
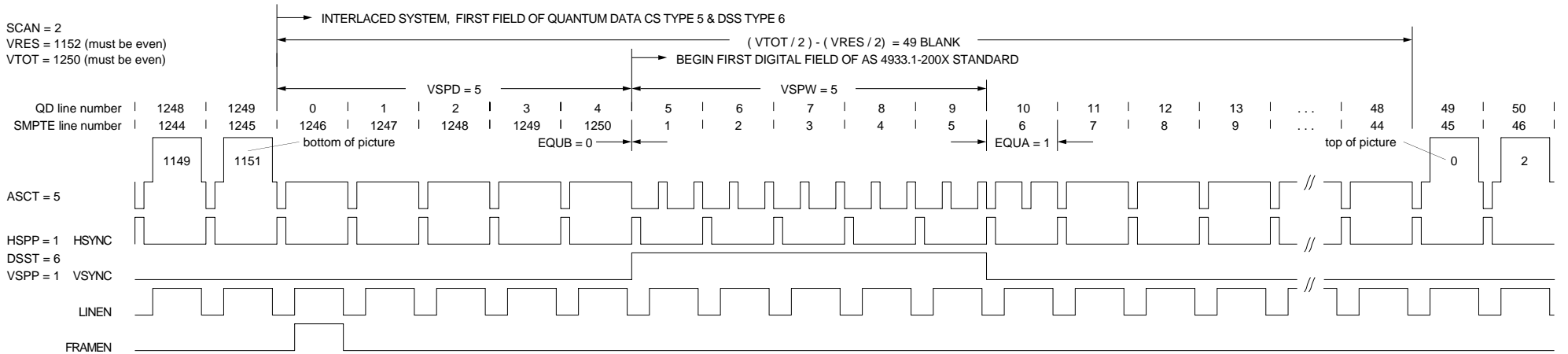
## NOTES

<sup>1</sup> Modern television signals (i.e. those described in Part 2 of ITU-R BT.709-5) are harmonically related to 148.5MHz, whereas legacy signals (i.e. those described in Part 1 of ITU-R BT.709-5) are not - they are instead tuned to harmonics of 144MHz. 148.5MHz and 144MHz are harmonics of 4.752GHz, which is out of the range of ordinary digital logic. Therefore, both sets of pixel frequencies cannot be easily derived from a common fixed clock source, without resorting to PLL technology. ITU-R BT.709-5 recommends that "for new HDTV programme production and international exchange, systems described in Part 2 [i.e. those based on 148.5MHz] are preferred". Quantum Data has created an alternate set of non-proprietary compatible Australian timings, whose line timings are slightly changed from the original 144MHz-based draft timings of AS 4933.1-200X. This alternate set is harmonically tuned to 148.5MHz in keeping with Part 2 of ITU-R BT.709-5. In order to allow formats from the two sets to be distinguished, the names of the modern "SMPTE-tuned" timings contain underline characters.

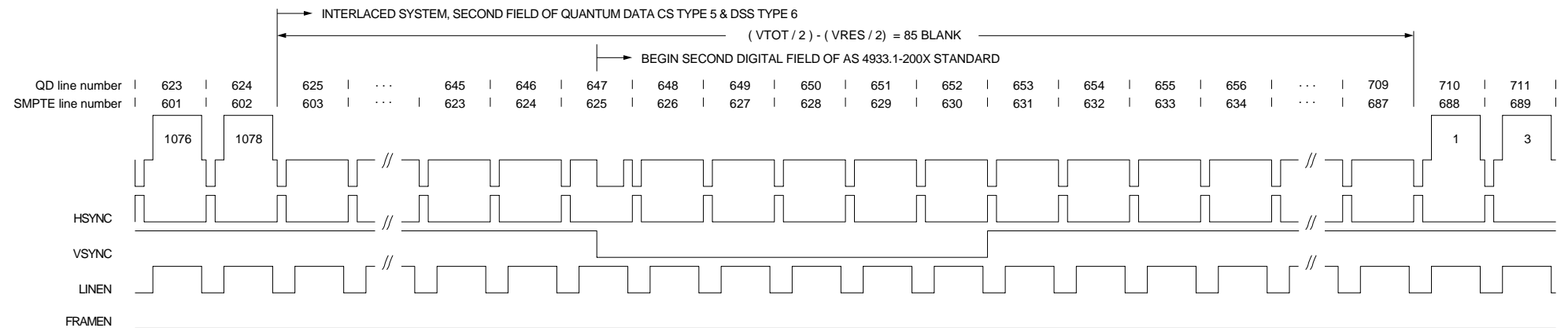
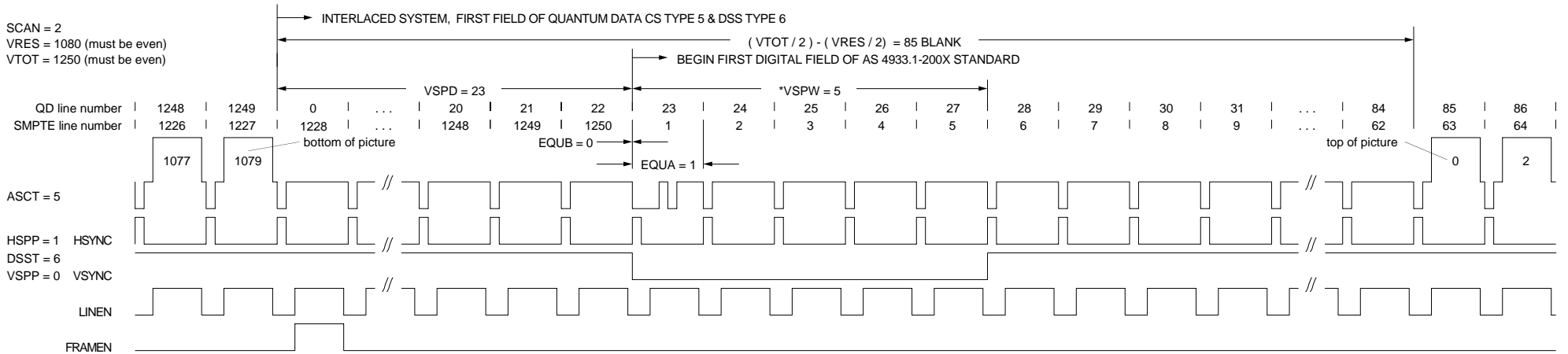
Set-Top-Box (STB)  
Standard Definition (SD)  
High Definition (HD)  
4:3 Aspect Ratio (A)  
16:9 Aspect Ratio (H)  
Widescreen Sampling Rate (W)  
Scope (S)

All vertical rates given are frame rates. The 576i50 formats listed have a field rate of 100Hz.

Legacy television content contains pixels having a nominal  $(4/720):(3/576)=1.0666:1$  rectangular shape, which require similarly shaped on-screen pixels in order to avoid distortion.



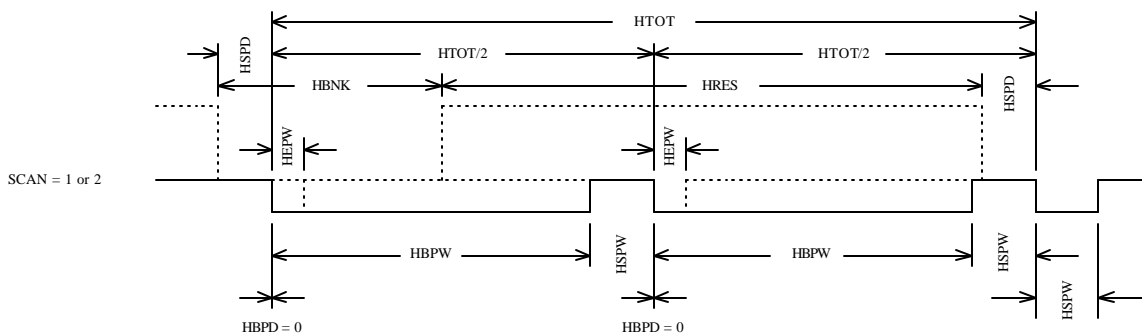
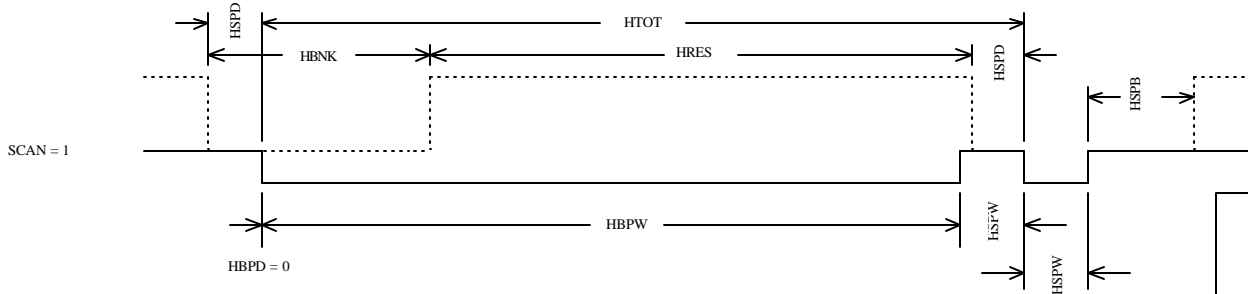
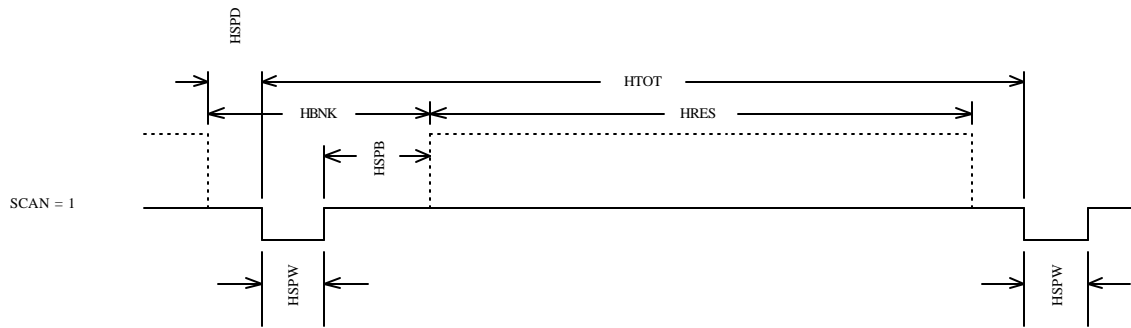
"Australian" Composite Sync Type 5 1152iSH (per AS4933.1-200X)



\* Special case: VSPW is reduced to 0.5-line, whenever analog sync is selected and the digital separate sync types have been programmed for opposite polarity (i.e. HSPP not equal to VSPP).

## "Australian" Composite Sync Type 5 1152iLH (per AS4933.1-200X)

ASCT	SCAN	HTOT	HRES	HBNK	HSPD	HSPW	HSPB	HEPW	HBDP	HBPW	HEPW =	HBPW =	FORMATS	STANDARDS
2	1	858	720	138	16	62	60	NA	NA	NA	NA	NA	DMT1043, IBM0675	EA RS-343-A
3	1	858	720	138	16	62	60	NA	0	842	NA	HTOT - HSPW + HVSA	480p	SMPTÉ 293M
3	1	1144	960	184	21	83	80	NA	0	1061	NA	HTOT - HSPW + HVSA	480pWH	SMPTÉ 267M
3	1	1152	960	192	16	84	92	NA	0	1068	NA	HTOT - HSPW + HVSA	576pWH	ITU-R BT.601-5 Part B
3	1	1188	960	228	19	100	109	NA	0	1088	NA	HTOT - HSPW + HVSA	576pWH_	576pWH at harmonic of SMPTÉ 274M 148.5 MHz
4	1 or 2	858	720	138	16	62	60	31	0	413	HSPW/2	(HTOT / 2) - HSPW + HVSA	480i	ITU-R BT.470-6 TYPE M
4	2	1152	720	432	136	84	92	42	0	492	HSPW/2	(HTOT / 2) - HSPW + HVSA	576i50WL	AS 4933.1-200X (letterboxed SD @ 100 fields/sec)
4	2	1188	720	468	139	100	109	50	0	494	HSPW/2	(HTOT / 2) - HSPW + HVSA	576i50_L	576i50WL at harmonic of SMPTÉ 274M 148.5 MHz
4	2	1152	960	192	16	84	92	42	0	492	HSPW/2	(HTOT / 2) - HSPW + HVSA	576i50WH	AS 4933.1-200X (widescreen HD @ 100 fields/sec)
4	2	1188	960	228	19	100	109	50	0	494	HSPW/2	(HTOT / 2) - HSPW + HVSA	576i50_H	576i50WH at harmonic of SMPTÉ 274M 148.5 MHz
5	2	1152	720	432	136	84	92	84	0	492	HSPW	(HTOT / 2) - HSPW + HVSA	1152iLA	AS 4933.1-200X (2/1 vertical scope 576 in 1152)
5	2	1188	720	468	139	100	109	100	0	494	HSPW	(HTOT / 2) - HSPW + HVSA	1152iLA_	1152iLA at harmonic of SMPTÉ 274M 148.5 MHz
5	2	1536	1280	256	21	112	123	112	0	656	HSPW	(HTOT / 2) - HSPW + HVSA	1152iSH	AS 4933.1-200X (8/5 vertical scope 720 in 1152)
5	2	1584	1280	304	25	133	146	133	0	659	HSPW	(HTOT / 2) - HSPW + HVSA	1152iSH_	1152iSH at harmonic of SMPTÉ 274M 148.5 MHz
5	2	2304	1920	384	32	168	184	168	0	984	HSPW	(HTOT / 2) - HSPW + HVSA	1152iLH	AS 4933.1-200X (6.7% letterbox 1080 in 1152)
5	2	2376	1920	456	38	200	218	200	0	988	HSPW	(HTOT / 2) - HSPW + HVSA	1152iLH_	1152iLH at harmonic of SMPTÉ 274M 148.5 MHz
6	1	864	720	144	12	64	68	NA	NA	NA	NA	NA	NONE	NONE
7	1	864	720	144	12	64	68	NA	0	800	NA	HTOT - HSPW + HVSA	576p	ITU-R BT.1358
8	1 or 2	864	720	144	12	64	68	32	0	368	HSPW/2	(HTOT / 2) - HSPW + HVSA	ITU0925X	ITU-R BT.470-6 TYPE I



- NOTES**
1. NA = not applicable
  2. SCAN = number of fields scanned per frame
  3. ASCT = analog sync composite type
  4. HVSA = 0 (horizontal vertical serration adjustment)
  5. Australian types 1152iLH\_ & 1152iLH are flagged by DSS HSPW ≠ VSPP (or ACS VSPW = 0.5) to signal the need for a 6.7% vertical size increase, while all other Australian types have DSS HSPW = VSPP (or ACS VSPW = 5).
  6. Legacy Australian types are harmonically related to 144MHz, while modern equivalents are harmonics of 148.5MHz.

## B i-level Sync Modes & Timing

Version 1.3  
06-19-2003  
M. Stockfisch

