Ordering number : ENA0077

SANYO Semiconductors
DATA SHEET

Monolithic Linear IC

LA7688B — PAL/NTSC Color Television-use Single-chip LSI

Overview

The LA7688B integrates VIF, SIF, video, chrominance, and deflection processing circuits for PAL/NTSC format TV sets on a single chip and is provided in a 52-pin shrink package.
The VIF and SIF circuits achieve semi-adjustment-free operation, and are adjustment-free except for the VCO coil and the RF AGC circuit. The chrominance circuit can be made adjustment-free by using the LC89950 1H delay line IC. All the signal processing required for a multi-format color TV can be implemented by combining this product with the LA7642 SECAM decoder IC.

Functions

- VIF, SIF, VIDEO, CHROMA DEFLECTION

Specitications

Absolute Maximum Ratings at Ta = 25 °C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{40} max		9	V
	V_{45} max		9	V
Maximum supply current	I_{24} max		16	mA
FBP input current	I_{26} max		5	mA
	I_{32} max		10	mA
FBP input voltage	V_{26} min		-5	V
Allowable power dissipations	Pd max	Ta ≤ 65°C, *Mounted on board	1.3	W
Operating temperature	Topr		-10 to +65	°C
Storage temperature	Tstg		-55 to +150	°C

*Board size : 83×86×1.5mm, material : bakelite

Operating Conditions at Ta = 25 °C

Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	V_{40}		7.6	V
	V_{45}		7.6	V
Recommended supply current	I_{24}		12	mA
Operating supply voltage range	V_{40} op		7 to 8.2	V
	V_{45} op		7 to 8.2	V
Operating supply current range	I_{24} op		10 to 16	mA

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Electrical Characteristics at Ta = 25°C, V_{CC} 40, 45 = 7.8V, I_{24} = 12mA

Parameter	Symbol	Conditions	Ratings min	Ratings typ	Ratings max	Unit
[Circuit voltage current]						
Horizontal supply voltage	V_{CC} H	Deflection block (V24)	6.4	6.9	7.4	V
Supply current	I_{40}		78	90	100	mA
	I_{45}		34	40	48	mA
[VIF block]						
RF AGC voltage max	V_{50}H		7.5	7.8	7.8	V
RF AGC voltage min	V_{50}L			0.2	0.6	V
Input sensitivity	V_I			39	45	dBμ
AGC range	GR		56	60		dB
Maximum allowable input	V_I max		95	100		dBμ
No-signal video output voltage	V_8		4.1	4.4	4.7	V
Sync signal tip voltage	V_8tip		1.7	2.0	2.3	V
Video output amplitude	V_O		1.7	2.0	2.3	Vp-p
Black noise threshold level voltage	V_{BTH}		1.0	1.3	1.7	V
Black noise clamp voltage	V_{BCL}		2.7	3.0	3.3	V
Output S/N	S/N		48	52		dB
1.07MHZ beat level	C/S		40	44		dB
Frequency characteristics	fc		6	9		MHz
Differential gain	DG			5	10	%
Differential phase	DP			6	10	deg
No-signal AFT voltage	V_7		3.6	3.9	4.2	V
Maximum AFT voltage	V_7H		7.3	7.6	7.8	V
Minimum AFT voltage	V_7L		0	0.3	0.7	V
AFT detection sensitivity tolerance frequency	S_f		10	15	20	mV/kHz
VIF input resistance	R_i	f = 38.9MHz		1.3		kΩ
VIF input capacitance	C_i	f = 38.9MHz	2	3	5	PF
APC pull-in range (U)	f_{PU}		0.8	2.0		MHz
APC pull-in range (L)	f_{PL}			-2.0	-0.8	MHz
Maximum variable range	Δf U1		0.8	2.0		MHz
	Δf L1			-2.0	-0.8	
SIF signal level	Sout		110	140	170	mVrms
VCO1 control sensitivity	β		1.4	2.8	5.6	kHz
[SIF block]						
SIF limiting sensitivity	V_I (lim)		40	46	52	dBμ
FM detection output voltage	V_O (FM)		390	500	710	mVrms
AMR	AMR		40	60		dB
Distortion	THD			0.3	1.0	%
SIF S/N	S/N (SIF)		55	62		dB
FM detection range (L)	W_{FM}L			2.5	4.0	MHz
FM detection range (H)	W_{FM}H		7.0	8.0		MHz
FM detection output variation	ΔV_O		0	2.0	3.0	dB
[INT/EXT SW block]						
AFT EXT gain	G_{AF}		-0.7	-0.2	+0.3	dB
AFT EXT distortion	THD_{AF}			0.03	0.5	%
System SW I-SE	V1 TH1	Comments ;	0		1.2	V
System SW I-P/N	V1 TH2	I = INT, E = EXT	1.7		2.6	V
System SW E-P/N	V1 TH3	P/N = PAL/NTSC	2.9		3.8	V
System SW E-SE	V1 TH4	SE = SECAM	4.1		5	V

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Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
[Video SW block]						
Video input 1 DC voltage	V_{10} DC		3.2	3.5	3.8	V
Video input 1 AC voltage	V_{10} AC			1.0		Vp-p
Video input 2 DC voltage	V_{14} DC		3.2	3.5	3.8	V
Video input 2 AC voltage	V_{14} AC			1.0		Vp-p
SVO pin DC voltage	V_{16} DC		2.5	2.8	3.1	V
SVO pin AC voltage	V_{16} AC		1.7	2.0	2.3	Vp-p
[Filter block]						
Filter automatic adjustment open voltage	V_9 OPN	fsc = 4.43MHz	3.3	3.8	4.3	V
S input threshold	V_9 TH		1.5	2.0	2.5	V
C-TRAP	G TRAP		-20	-26	-32	dB
C-BPF1	G BPF1		-5	-3	-1	dB
C-BPF2	G BPF2		-2	-1	0	dB
C-BPF3	G BPF3		-6	-4	-2	dB
Y-DL time 1	T dy1	PAL	400	450	500	ns
Y-DL time 2	T dy2	NTSC	410	460	510	ns
Y-DL time 3	T dy3	S (PAL)	230	280	330	ns
Y-DL time 4	T dy4	SECAM	510	560	610	ns
[Video block]						
Contrast center	E CCEN		1.0	1.2	1.4	Vp-p
Contrast variable range	dGC		18.0	22.0	26.0	dB
Bright min (0.5V)	VB min		0.4	0.7	1.0	V
Bright typ (2.5V)	VB typ		1.9	2.2	2.5	V
Bright max (4.5V)	VB max		3.4	3.7	4.0	V
Soft control characteristics	dGSOFT		-6.0	-4.0	-2.0	dB
Sharp control characteristics	dGSHARP		4.5	7.5	10.5	dB
Y signal frequency characteristics (1)	BW1	S-VHS	4.5	5.0	5.5	MHz
Y signal frequency characteristics (2)	BW2	PAL	3.2	3.63	4.0	MHz
Y signal frequency characteristics (3)	BW3	NTSC	2.6	3.05	3.4	MHz
DC transmission ratio	dVAPL			100		%
Black expansion threshold	B STH		40	50	60	IRE
Black expansion maximum gain	BS max		-20	-13	-6	IRE
[Chroma common]						
R-Y output DC voltage	V_{39} DC		3.6	4.0	4.4	V
R-Y output AC voltage	E_{39} AC		0.4	0.55	0.7	Vp-p
B-Y output DC voltage	V_{38} DC		3.6	4.0	4.4	V
B-Y output AC voltage	E_{38} AC		0.3	0.45	0.6	Vp-p
R-Y input DC voltage	V_{37} DC		4.2	4.6	5.0	Vp-p
R-Y input AC voltage	E_{37} AC		0.4	0.55	0.7	Vp-p
R-Y input AC range	V_{37} ALC		160	200	250	Vp-p
B-Y input DC voltage	V_{36} DC		4.2	4.6	5.0	V
B-Y input AC voltage	E_{36} AC		0.3	0.45	0.6	Vp-p
B-Y input AC range	E_{36} ALC		160	200	250	mVp-p
Color residue	E CMIN				200	mVp-p
Contrast color amplitude characteristics	dGCC		30	35	40	dB
RGB difference output DC difference voltage	dVC	Chroma no input	-0.3	0.0	0.3	V
RGB difference output DC voltage temperature characteristics	∂VC-Y/∂T	Chroma no input		0.0		mV/°C
RGB difference residual distortion level	E car				0.2	Vp-p
RGB difference output residual carrier level	e car	Chroma no input			0.3	Vp-p

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Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
fsc output pin DC voltage	V_{27} OPN		4.5	5.0	5.3	V
fsc output level P	V_{27} ACP	PAL	0.14	0.2	0.26	Vp-p
fsc output level N	V_{27} ACN	NTSC	0.19	0.26	0.33	Vp-p
DEF COIN-L	V_{27} LO		1.0	1.3	1.6	V
Xtal SW threshold	V_{27} TH			400		µA
PAL SW threshold	V_{18} PTH				0.6	V
NT SW threshold	V_{18} NTH		0.9			V
[Chroma PAL block]						
ACC amplitude characteristics 1	ACC1p		-2	1	+4	dB
ACC amplitude characteristics 2	ACC2p		-4	0	+2	dB
Killer operating point	E KILp		-37	-30	-25	dB
Killer hysteresis	dE KILp		1	3	7	dB
RGB output level	E Bp	Chroma 50%, Color typ	3.5	4.0	4.5	Vp-p
Maximum RGB output	EBMAXp	Chroma 50%, Color max	5.0	5.5	6.0	Vp-p
APC pull-in range+	df scp+		500			Hz
APC pull-in range-	df scp-				-500	Hz
Demodulator output ratio B/R	B/Rp		1.5	1.78	2.00	double
Demodulator output ratio G/R	G/Rp	B-Y no signal	-0.56	-0.51	-0.46	double
Demodulator output ratio G/B	G/Bp	R-Y no signal	-0.21	-0.19	-0.17	double
Demodulation angle	RBp		85	90	95	deg
[Chroma NTSC block]						
ACC amplitude characteristics 1	ACC1n		0	3	+6	dB
ACC amplitude characteristics 2	ACC2n		-4	0	+2	dB
ACC phase characteristics 1	PCC1n		-5	0	+5	deg
ACC phase characteristics 2	PCC2n		-5	0	+5	deg
Killer operating point	E KILn		-40	-34	-29	dB
Killer hysteresis	dE KILn		1	4	8	dB
RGB output level	E Bn	Chroma 50%, Color typ	2.8	3.2	3.6	Vp-p
Maximum RGB output	EBMAXn	Chroma 50%, Color max	4.5	5.0	5.5	Vp-p
APC pull-in range+	df scn+		350			Hz
APC pull-in range-	df scn-				-350	Hz
Tint variable range	dP TI		-33		+50	deg
Demodulator output ratio R	R/Bn		0.81	0.9	0.99	double
Demodulator output ratio G	G/Bn		0.24	0.30	0.36	double
Demodulation angle RB	RBn		95	105	115	deg
Demodulation angle GB	GBn		-130	-120	-110	deg
[RGB block]						
OSD input level	E OSD	Typical input, 100% white level		0.7		Vp-p
OSD input DC voltage	V OSD	No signal	2.9	3.2	3.5	V
F-BLK input threshold level	V_{28} TH		0.8	1.0	1.2	V
OSD output pedestal level	V OSDC		-0.3	0	+0.3	Vp-p
OSD output MAX	E OSD max		4.3	4.8	5.3	Vp-p
OSD output MIN	E OSD min		0.3	0.6	0.9	Vp-p
OSD signal frequency characteristics	BW OSD		5	7		MHz
TV-OSD crosstalk (R, G, B)	C TTVY		50			dB
OSD-TV crosstalk (R, G, B)	C TOSDC		40			dB
Teletext inter channel CH crosstalk	C TOSD		30			dB
[DEF block]						
Horizontal free-running frequency 50	TVFREE50		312	312.5	313	H
Horizontal free-running frequency 60	TVFREE60		262	262.5	263	H

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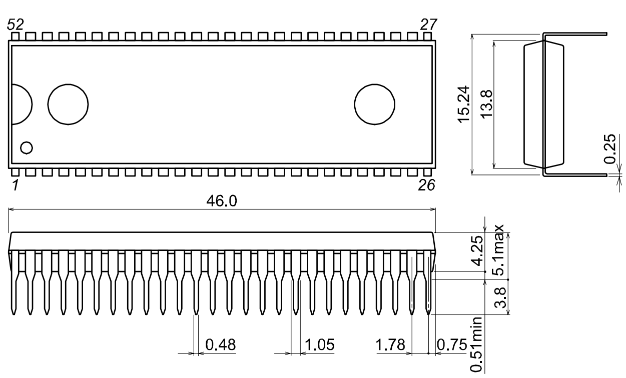
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Horizontal sync maximum cycle 50	TV MAX50	Vertical sync signal only	356.5	357	357.5	H
Horizontal sync maximum cycle 60	TV MAX60	Vertical sync signal only	296.5	297	297.5	H
Horizontal sync minimum cycle 50	TV MIN50		268.5	269	269.5	H
Horizontal sync minimum cycle 60	TV MIN60		224.5	225	225.5	H
Horizontal blanking peak value	VHVBL			0.6	1.0	V
Horizontal blanking pulse width 50	PWBLK50		23	23.5	24	H
Horizontal blanking pulse width 60	PWBLK60		19	19.5	20	H
Horizontal blanking pulse width	PWVOUT		8	8.5	9	H
Horizontal output voltage H	$V_{OUT}H$		5.3	5.6	5.9	V
Horizontal output voltage M	$V_{OUT}M$		4.0	4.3	4.6	V
Horizontal output voltage L	$V_{OUT}L$				0.3	V
Vertical external trigger load resistance	R_{TR}		3.0	4.7		kΩ
Vertical automatic sync stop voltage	V_{SAS}			1.4	1.9	V
Vertical AFC gate release voltage	V_{GS}			2.0	2.5	V
Horizontal output start V_{CC} voltage	S_{VV}			4.2	4.7	V
Vertical free-run frequency deviation	ΔfH		-150	0	150	Hz
Dependence of vertical free-run frequency on V_{CC}	$\Delta fH/V_{CC}$			2		Hz
Vertical pull-in range	fHPULL		±450			Hz
Vertical output start V_{CC} voltage	S_{HV}			4.8	5.2	V
AFC2 FBP peak value H	F_{BPH}		6.0	6.5	7.0	V
AFC2 FBP peak value M	F_{BPM}		3.2	3.7	4.2	V
AFC2 FBP peak value L	F_{BPL}		-0.3	0.2	0.7	V
Vertical output pulse width	P_{WHOUT}		21.8	23.8	25.8	µs
Vertical output phase max	H_{PMAX}		14	17		µs
Vertical output phase center	H_{PCEN}		4.8	5.8	6.8	µs
Vertical output phase min	H_{PMIN}			3.8	4.8	µs
Burst gate pulse width	P_{WBGP}		3	4	5	µs
Burst gate pulse phase	T_{dBGP}		-0.2	0.3	0.8	µs
50/60 output voltage 50	V_{50}			1.1	1.5	V
50/60 output voltage 60	V_{60}		3.8	4.1		V
50/60 input voltage 50	$V_{IN}50$		0.5			V
50/60 input voltage 60	$V_{IN}60$				7.0	V
SECAM V pulse peak value	SVH		1.8	2.2	2.6	V
SECAM V pulse width	SVW		11.0	11.5	12.0	H

Package Dimensions

unit : mm

3128



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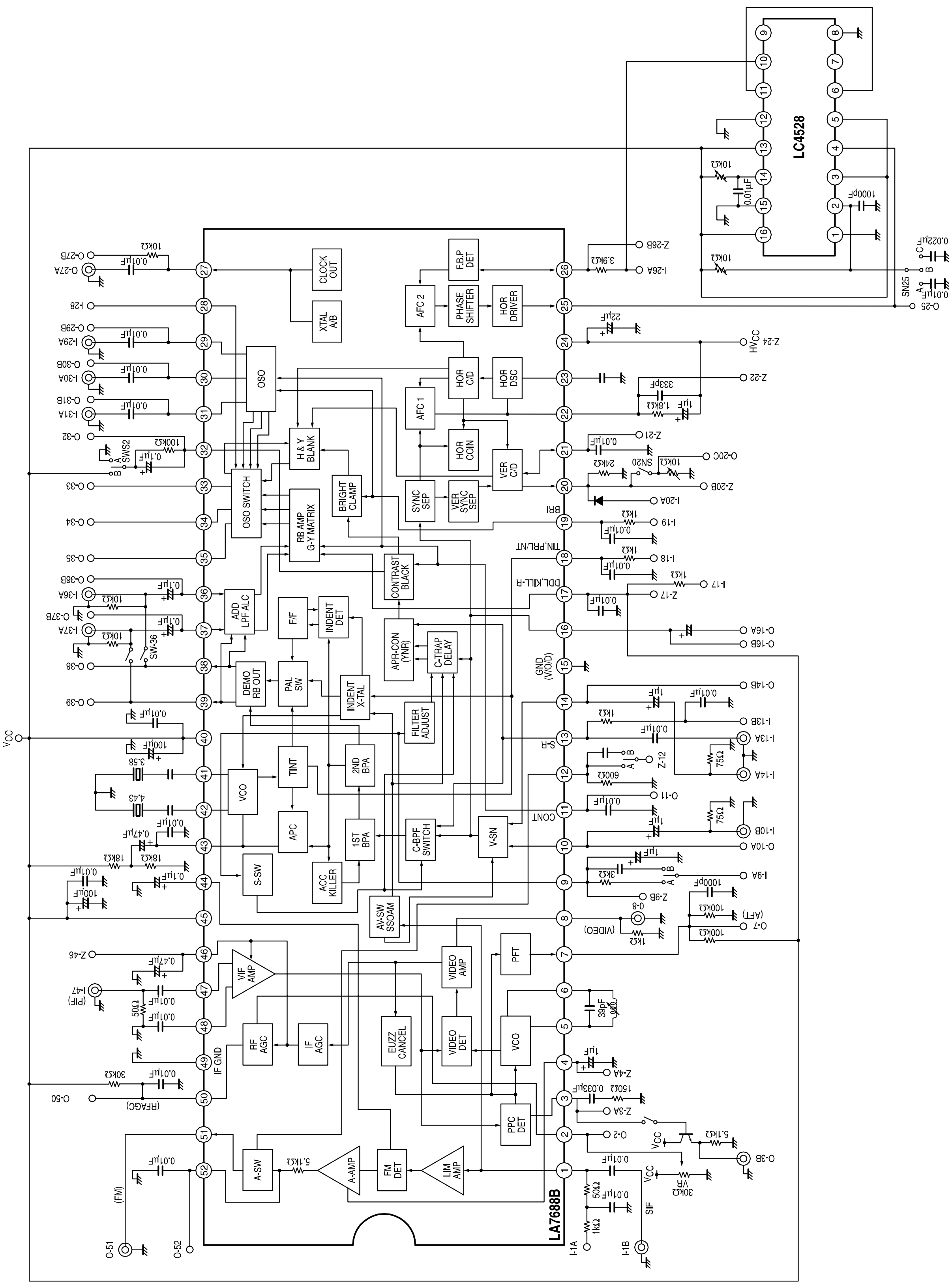
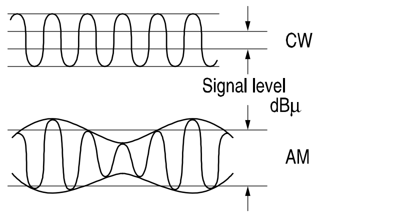
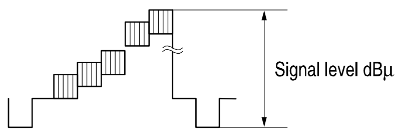
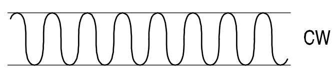
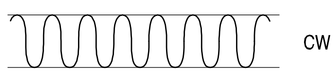
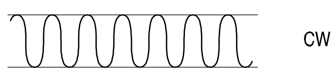
Block Diagram and Measurement Circuit Diagram



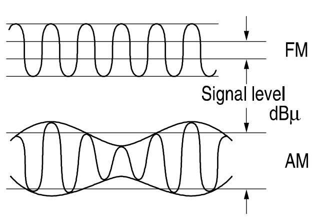
VIF Input Signals and Test Conditions

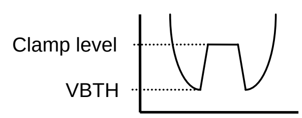
1. All input signals must be applied to VIF IN shown in the test circuit diagram.
2. The indicated voltage values of the input signals are all measured at VIF IN shown in the test circuit diagram.
3. All switches must be set to OFF unless otherwise specified.
4. All VRs must be set to their center position unless otherwise specified.
5. The input signals and their levels are summarized below.

Input Signals	Waveform	Conditions
SG1		38.9MHz or variable frequency 38.9MHz, 40% or 78% MOD
SG2		38.9MHz, 87.5% VIDEO MOD 10-step waveform (subcarrier : 4.43MHz) standard signal
SG3		34.47MHz
SG4		33.4MHz
SG5		Sweep signal, center frequency = 38.9MHz

SIF Block Input Signal and Test Conditions

1. The SIF block input signal must be applied to SIF IN shown in the test circuit diagram.
2. The indicated voltage value of the input signal is measured at SIF IN shown in the test circuit diagram.
3. All switches must be set to OFF unless otherwise specified.
4. All VRs must be set to their center position unless otherwise specified.
5. The input signals and their levels are summarized below.

Input Signals	Waveform	Conditions
SG1 (SIF IN)		5.5MHz, Δf = ±30kHz 5.5MHz, 30% MOD

Parameter	Symbol	Test point	Input symbol	Test method	Applied voltage (V)	
					TPO-2	TPZ-46
[VIF block]						
RF AGC voltage max	$V_{50}H$	TPO-50	SG1, fp = 38.9MHz cw, 85dBμ	Measure the level at TP0-50 using a DC digital voltmeter.	7.8V	Open
RF AGC voltage min	$V_{50}L$	TPO-50	Same as above	Same as above	0	Open
Input sensitivity	V_I	TPO-8 +100k	SIG1 fp = 38.9MHz fm = 400Hz AM = 40% mod	Monitor the level at TP0-8 using an oscilloscope with a resistor of 100kΩ connected to TP0-8. Measure the VIF input level at which the 400Hz demodulation signal level becomes 0.8Vp-p.	VR center	Open
AGC range	GR	TPO-8	Same as above	Monitor the level at TP0-8 using an oscilloscope and measure the VIF input level at which the 400Hz demodulation signal level becomes 0.8Vp-p. Assign the measured value to V_I. GR = 20log (V_I'/V_I) [dB]	VR center	7.8V
Maximum allowable input	$V_I$max	TPO-8	SG1 fp = 38.9MHz, fm = 15kHz, AM = 78% mod	Increase the VIF input relative to the output level at TO0-8 when the VIF input is 80dBμ and measure the VIF input level at which the output level increases by 1dB.	VR center	Open
No-signal video output voltage	V_8	TPO-8	No-signal	Measure the level at TO0-8 using a DC digital voltmeter.	VR center	7.8V
Sync signal tip voltage	V_8TIP	TPO-8	SG1, fp = 38.9MHz cw, 80dBμ	Same as above	VR center	Open
Video output amplitude	VO_8	TPO-8	SIG fp = 38.9MHz, fm = 15kHz, AM = 78% MOD 80dBμ	Monitor the level at TP0-8 using an oscilloscope and measure the p-p value of the 15kHz demodulation waveform.	VR center	Open
Black noise threshold voltage	VBTH	TPO-8	SG1 fp = 38.9MHz fm = 400Hz AM 78% MOD	Connect an oscilloscope to TP0-8 and input a sweep signal to the VIF input. Apply voltage to TPZ-46 externally and adjust it as shown below. 	VR center	Variable
Black noise clamp voltage	VBCL	TPO-8	Same as above	Measure the level at clamp voltage of shown above.	VR center	Variable
Video S/N	S/N	TPO-8	SG1, fp = 38.9MHz cw, 80dBμ	Using an RMS voltmeter, measure a noise voltage generated at TO0-8 through a band-pass filter of 10kHz to 5MHz. S/N = 20log (1.43 (Vp-p) /noise voltage (Vrms)) [dB]	VR center	Open
1.07MHz beat level	I1.07	TPO-8	SG1, fp = 38.9MHz, cw, 80dBμ SG3, fc = 4.43MHz, cw, 70dBμ SG4, fs = 5.5MHz, cw, 70dBμ	Mix the SG1 signal, SG3 signal, and SG4 signal and input the mixed signal to VIF IN. (The level at VIF IN must be as shown left.) Connect an oscilloscope and a spectrum analyzer to TP0-8 and adjust the external voltage at TPZ-46 so that the lower end of the demodulation waveformbecomes 3V. Measure the differential component between 4.43MHz and 1.07MHz using the spectrum analyzer.	VR center	Variable

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Parameter	Symbol	Test point	Input symbol	Test method	Applied voltage (V)	
					TPO-2	TPZ-46
Frequency characteristics	fc	TPO-8	SG2, fp = 38.9MHz, cw, 80dBμ SG1, fc = 38.8MHz to 25MHz, cw 66dBμ	Mix the SG1 signal and SG2 signal and input the mixed signal to VIF IN. Set the SG1 frequency at 38.8MHz and using an oscilloscope adjust the external voltage at TPZ-46 so that the output level at TP0-8 becomes 3V. And then lower the SG1 frequency until the output level at TP0-8 becomes 0.35Vp-p. Measure the frequency at that moment. fc = 38.9-f [MHz]	VR center	Variable
Differential gain	DG	TPO-8	SG1, fp = 38.9MHz, staircase wave AM = 87.5% MOD 80dBμ	Measure the level at TP0-8 using a vector scope.	VR center	Open
Differential phase	DP	TPO-8	Same as above	Same as above	VR center	Open
No-signal AFT voltage	V_7	TPO-7	No-signal	Measure the level at TP0-7 using a DC digital voltmeter.	VR center	7.8V
Maximum AFT voltage	V_7H	TPO-7	SG1, fp = 38.9MHz ±1MHz, cw, 80dBμ	Connect a DC digital voltmeter to TO0-7 and vary the SG frequency ±1MHz tomeasure a maximum voltage.	VR center	Open
Minimum AFT voltage	V_7L	TPO-7	Same as above	Connect a DC digital voltmeter to TO0-7 and vary the SG frequency ±1MHz to measure a minimum voltage.	VR center	Open
AFT detection sensitivity	Sf	TPO-7	SG1 fp = 38.9MHz, ±1MHz, cw, 80dBμ	Connect a DC digital voltmeter to TO0-7 and vary the SG frequency ±1MHz to measure frequency deviation Δf when the voltage changes from 2V to 7V. $Sf = \frac{5000(mV)}{\Delta f\,(kHz)}$ [mV/kHz]	VR center	Open
APC pull-in range (U)	f_{PU}	TPO-8	SG5 fp = 38.9MHz 5MHz cw, 50dB	Connect an oscilloscope to TP0-8 and set the SG5 frequency at a frequency higher than 38.9MHz to unlock the PLL. (The PLL is assumed to be unlocked when a beat signal appears at TO0-8.) When the SG5 frequency is lowered, the PLL is unlocked again. Measure the frequency at that moment and assign the measured frequency to f_{PU}. For f_{PL}, set the SG5 frequency at a frequency lower than 38.9MHz and make measurements in the	VR center	Open
APC pull-in range (L)	f_{PL}	TPO-8	Same as above	Same as above	VR center	Open
VCO1 maximum variable range	ΔfU ΔfL	TPO-8	No-signal	Connect a spectrum analyzer to TO0-8 and check to see that the VCO oscillation frequency is 9MHz. And then apply DC voltage to TPZ-4A and vary it. Assign the frequency max. at TO0-8 to fU max. and the frequency min. at TP0-8 to fL min. ΔfU = fUmax-38.9MHz ΔfL = 38.9MHz-fLmin	VR center	7.8V

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Parameter	Symbol	Test point	Input symbol	Test method	Applied voltage (V)	
					TPO-2	TPZ-46
VCO1 control sensitivity	β1	TPO-8	No-signal	Connect a spectrum analyzer to TP0-8 and check to see that the VCO oscillation frequency is 38.9MHz. And then apply DC voltage to TPZ-3A and vary it from 3.2V to 2.8V. Assign the frequency range at that moment to Δf. $\beta = \frac{\Delta f kHz}{400 mV}$	VR center	
[SIF block]						
SIF limiting sensitivity	Vilim	TPO-52	SG1 fo = 5.5MHz fm = 400Hz FM : Δf = ±30kHz	With the SG1 output level being 100dBμ, measure the level at TP0-52 using an AC voltmeter. And then lower the SG1 output level and measure the SIF input level when the reading on the AC voltmeter drops 3dB. (AC voltmeter input resistance = 1MΩ)	VR center	7.8V
FM detection sensitivity	V_{52}	TPO-52	Same as above 100dBμ	Measure the level at TP0-52 using an AC voltmeter. (AC voltmeter input resistance = 1MΩ)	VR center	7.8V
AM rejection ratio	AMR	TPO-52	SG1 fo = 5.5MHz fm = 400Hz AM = 30% MOD 100dBμ	Measure the level at TP0-52 using an AC voltmeter and assign the measured value to V52'. (Input resistance=1MHz) AMR is calculated relative to the VO1 value of Test No.2 as shown below. $AMR = \frac{V52(mVrms)}{V52'(mVrms)}[dB]$	VR center	7.8V
FM detection output distortion	THD	TPO-52	SG1 fo = 5.5MHz fm = 400Hz FM : Δf = ±30kHz 100dBμ	Measure the distortion at TP0-52 using a distortion meter.	VR center	7.8V
SIF S/N	S/N (SIF)	TPO-52	SG1 fo = 5.5MHz, cw	Measure the level at TP0-52 using an AC voltmeter. Assign the measured value to Vn. (Use a filter of 20Hz to 20kHz.) S/N = 20logV52/Vn (dB)	VR center	7.8V
FM detection range	WFM	TPO-52	SG1 fo = 5.5MHz, Δf = ±3kHz fm = 400Hz	Connect an oscilloscope to TP0-52 and lower the SG1 frequency to measure the lower pull-in characteristic. Assign the measured value to fL. In the same manner, raise the SG1 frequency to measure the upper pull-in characteristic. Assign the measured value to fU. WFM : fL≤4.0MHz fU≥7.0MHz	VR center	7.8V
FM detection output variation	ΔV_O	TPO-52	SG1 fo = 5.5MHz, Δf = ±30kHz fm = 400Hz	Connect an AC voltmeter to TP0-52 and vary the SG1 frequency from 4.5MHz to 6.5MHz. Take Vo as the reading on the AC voltmeter. ΔV_O : -1.5dB≤Vo≤1.5dB	VR center	7.8V

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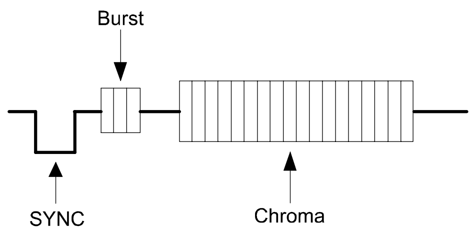
Parameter	Symbol	Test point	Input symbol	Test method	Applied voltage (V)	
					TPO-2	TPZ-46
SIF signal level	Sout	TPO-8	SG1 fp = 38.9MHz cw 80dBμ SG2 fp = 33.4MHz cw 60dBμ	Mix SG1 and SG2 and enter the mixed signal to VIF IN. Connect the spectrum analyzer to TPO-8 and measure the 5.5MHz level.	VR center	OPEN
[AUDIO SW block]						
AF EXT gain	GAF	TPO-51	SG1 fo = 400Hz Vf = 500mVrms	Apply the DC voltage so that I-1A becomes EXT. Enter SG1 from Z-12 and connect the AC voltmeter to TPO-51. Measure the 400Hz level and set it as V51. GAF = 20log V51/500mVrms	VR center	7.8V
AF EXT distortion	THDAF	TPO-51	SG1 fo = 400Hz Vf = 500mVrms	Apply the DC voltage so that I-1A becomes EXT. Enter SGI from Z-12 and connect a distortion factor meter to TPO-51. Measure the distortion factor in this case. B.P.F 20Hz to 20kHz	VR center	7.8V

Description of LA7688B chroma block input waveforms

1. The color bar signals which are input from pin 10 and pin 14 are a standard composite video signal.

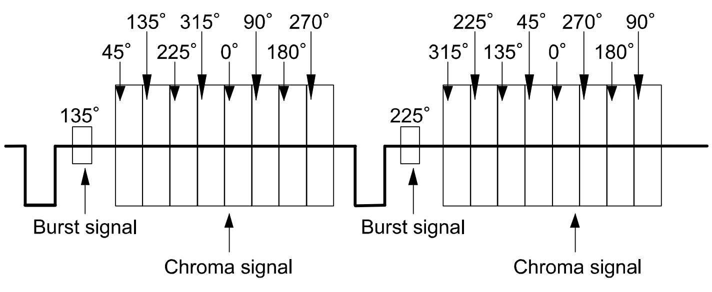
(1) Color bar : 0dB
Composite video signal with 1Vp-p color bar

(2) Monochrome signal
[PAL] SYNC : 0.3Vp-p Burst : 300mVp-p Chroma : 600mVp-p
[NTSC] SYNC : 0.3Vp-p Burst : 286mVp-p Chroma : 572mVp-p



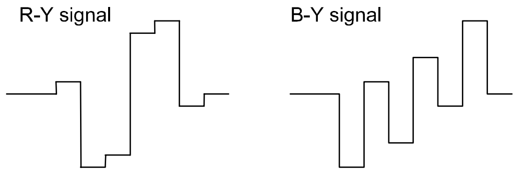
(3) Burst only
Signal obtained by eliminating the chroma component from the signal of (2)

(4) 8-division signal



(5) SECAM signal

R-Y, B-Y demodulation signal



2. The chroma signal which is input from pin 13 (S-CHROMA IN) is assumed to be a PAL chroma signal.

INT/EXT SW block, SAB block, VIDEO SW block, FILTER block Input signals and test conditions

Set up the following conditions unless otherwise specified for each test item.
(VIF, SIF blocks : No signal)

1. Input signals
   INT SECA --- INT IN (pin 10) 1Vp-p : SECAM color bar
   INT PAL --- INT IN (pin 10) 1Vp-p : PAL color bar
   EXT PAL --- EXT IN (pin 14) 1Vp-p : PAL color bar
   EXT SECA --- EXT IN (pin 14) 1Vp-p : SECAM color bar
   EXT NT --- EXT IN (pin 14) 1Vp-p : NTSC color bar
   AUDIO IN --- EXT AUDIOIN (12pin) 1Vrms SIN wave (1kHz)
2. S-CHROMA IN (pin 13) : DC5V+Chroma signal
3. VR control position : Contrast VR-4V, sharpness VR-2V, others-control center
4. V_{CC}, I_{CC} conditions : V_{CC} = 7.8V, I_{CC} = 12mA.

Parameter	Symbol	Test point	Input conditions	Test method	V-SW Pin 1
[INT/EXT SW block]					
AFT EXT gain	GAF	O-51	EXT PAL I-12	Measure the gain difference between input and output. (f = 400Hz, 500mVrms)	3.3V
INT/EXT crosstalk (AUDIO)	THDAF	O-51	EXT PAL I-12	Measure the distortion factor of the output. (f = 400Hz, 500mVrms)	3.3V
System SW I-SE	V_1TH1	O-16A O-39	INT SECA	Check to see that the selected signal is INT-SECAM.	0V 1.2V
System SW I-P/N	V_1TH2	O-16A O-39	INT PAL	Check to see that the selected signal is INT-PAL.	1.7V 2.6V
System SW E-P/N	V_1TH3	O-16A O-39	EXT PAL	Check to see that the selected signal is EXT-PAL.	2.9V 3.8V
System SW E-SE	V_1TH4	O-16A O-39	EXT SECA	Check to see that the selected signal is EXT-SECAM.	4.1V 5V

Parameter	Symbol	Test point	Input conditions	Test method	Contrast	Sharpness	Bright
Y signal frequency characteristics (3) (NTSC MODE)	BW3	O-32	f = variable 100mVp-p	Measure the frequency at which the output level drops by 3dB relative to that when f = 100kHz is set.	4V	1.8V	2.5V
DC transmission ratio	DVAPL	O-32	White 100% black	Measure the output pedestal level variations when a white 100% signal and a black signal are input.	4V	2V	2.5V
Black expansion threshold	BSTH	O-33	I-14	Set S32 to "B". Connect an oscilloscope to 0-33 and measure the level of 5IRE expansion when the RAMP signal APL is changed for a range from 10% to 90%.	4V	2V	2.5V
Maximum black expansion gain	Bsmax	O-33	I-14	Set S32 to "B". Connect an oscilloscope to 0-33 and measure the change in the pedestal level when the RAMP signal APL is changed to 90%.	4V	2V	2.5V

Parameter	Symbol	Test point	Input signal	Test method	COLOR VR	CONTRAST	TINT VR
RGB output DC difference voltage	DVC	O-33 O-34 O-35	(3)	Obtain the DC difference voltage of each output measured for Parameter "RGB difference output DC voltage".	2.5V	4V	0V
RGB output residual harmonic level	Ecar2	O-33 O-34 O-35	(3)	Measure the residual harmonic level for the scanning period each of RGB difference outputs. (SHARP : 0V)	2.5V	4V	0V
RGB output carrier leak	Ecar	O-33 O-34 O-35	(2)	Measure the residual carrier level for the scanning period each of RGB difference outputs. (SHARP : 0V)	2.5V	4V	0V
fsc output pin DC voltage	V_{27}OPN	Z-27B	(3)	Measure the DC voltage.	2.5V	4V	0V
fsc output level P	V_{27}ACP	Z-27A	(3)	Measure the AC voltage.	2.5V	4V	0V
fsc output level N	V_{27}ACN	Z-27A	(3)	Measure the AC voltage.	2.5V	4V	3V
DEF COIN-L	V_{27}LO	Z-27B	No signal	Measure the DC voltage.	2.5V	4V	0V
Xtal SW threshold	V_{27}A	Z-27A	No signal	Measure the frequency voltage.	2.5V	4V	0V
PAL SW threshold	V_{18}PTH	O-35	(1) PAL	Measure the AC voltage.	2.5V	4V	0.6V
NT SW threshold	V_{18}NTH	O-35	(1) NT	Measure the AC voltage.	2.5V	4V	0.9V
[Chroma block PAL]							
ACC amplitude characteristics	ACC1p	O-33	(1) 0dB/6dB	Measure the output's Vp-p value. After chaning the input signal level from 0dB to 6dB, measure the B output's Vp-p value and calculate the ratio in dB to the B output's Vp-p value when the input signal level is 0dB.	2.5V	4V	0V
	ACC2p	O-33	(1) -20dB	In the same manner, obtain the amplitude variations when the input signal level is changed from 0dB to -20dB.	2.5V	4V	0V
Killer operating point	EKILp	O-33	(1) : Level variable	Attenuate the input signal level from 0dB until there comes a point where the B output ceases ; that point is the killer operating point.	2.5V	4V	0V
Killer hyesteresis	DEKILp	O-33	(1) : Level variable	Measure the difference between killer-on level and killer-off level.	2.5V	4V	0V
RGB output level	Ebp	O-33	(1) Y-OFF Chroma 50%	Measure the Vp-p value of the B output's signal component. BRIGHT : 5V	2.5V	4V	0V
Maximum RGB output	EBMAXp	O-33	(1) Y-OFF Chroma 50%	Measure the Vp-p value of the B output's output amplitude. BRIGHT : 5V	5V	4V	0V
APC pull-in range	Dfscp+ Dfscp-	O-27A	(1) fsc frequency variable	Vary the subcarrier frequency to measure the pull-in frequency and calculate the difference from fsc.	2.5V	4V	0V

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Parameter	Symbol	Test point	Input signal	Test method	COLOR VR	CONTRAST	TINT VR
Demodulator output ratio	B/RP	O-33 O-35	(4)	Calculate the ratio between output amplitude BM corresponding to 0 degrees and 180 degrees of the chroma input in the B output and output amplitude RM corresponding to 90 dgrees and 270 degrees of the chroma input in the R output.	2.5V	4V	0V
	G/RP	O-34 O-35	(4)	Measure the output amplitude corresponding to 90 degrees and 270 degrees of the chroma input in the G output and calculate the ratio to the above RM.	2.5V	4V	0V
	G/BP	O-33 O-34	(4)	Measure the output amplitude corresponding to 0 dgrees and 180 degrees of the chroma input in the G output and calculate the ratio to the above BM.	2.5V	4V	0V
Demodulation angle	∠RBP	O-33 O-35	(4)	Take Ba and Bb as the output amplitudes corresponding to the first and the third of the chroma 8-division signal inputs in the B output respectively and calculate by using the following formula. For the R output also, calculate with Ra and Rb. $Tan^{-1}(Bb/Ba)+$ $Tan^{-1}(Rb/Ra)$	2.5V	4V	0V
[Chroma block NTSC]							
ACC amplitude characteristics 1/2	ACC1n	O-33	(1) 0dB/6dB	Adjust the relative phase of the SG's chroma and burst so that the B output assumes a horizntal waveform. And then measure the B output's Vp-p value. After changing the input signal level from 0dB to 6dB, adjust the relative phase of the SG's chroma and burst again when the B-Y output assumes a horizontal waveform ; that adjusted phase amount is PCC1n. Measure the B output's Vp-p at that moment and calculate the ratio in dB to the B output's Vp-p when the input signal level is 0dB ; that ratio is ACC1n.	2.5V	4V	3V
	ACC2n	O-33	(1) -20dB	In the same manner as above, measure the variations of the amplitude and phase when the input signal level is changed from 0dB to -20dB.	2.5V	4V	3V
ACC phase characteristics 1/2	PCC1n	O-33	(1) 0dB/6dB	Same as for ACC1.	2.5V	4V	3V
	PCC2n	O-33	(1) -20dB	Same as for ACC2.	2.5V	4V	3V
Killer operating point	EKILn	O-33	(1) : Level variable	Attenuate the input signal level from 0dB until there comes a point where the B output ceases ; that point is the killer operating point.	2.5V	4V	3V
Killer hysteresis	DEKILn	O-33	(1) : Level variable	Measure the difference between killer-on level and killer-off level.	2.5V	4V	3V
RGB output level	EBn	O-33	(1) Y-OFF chroma 50%	Adjust the SG so that the B output assumes a horizontal waveform and measure the Vp-p value of the B output's signal component. BRIGHT : 5V	2.5V	4V	3V

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Parameter	Symbol	Test point	Input signal	Test method	COLOR VR	CONTRAST	TINT VR
Maximum RGB output	EBMAXn	O-33	(1) Y-OFF chroma 50%	Adjust the SG so that the B output assumes a horizontal waveform and measure the Vp-p value of the B output's signal component. BRIGHT : 5V	5V	4V	3V
APC pull-in range	Dfscn+ Dfscn-	O-27A	(1) fsc frequency variable	Vary the subcarrier frequency to measure the pull-in frequency and calculate the difference from fsc.	2.5V	4V	3V
Tint center	TCEN	O-33	(1) Y-OFF	Make the relative phase of the SG's chroma and burst normal. Adjust the relative phase of the SG's chroma and burst so that the B output assumes an oblique linear waveform. That phase amount adjusted relative to the normal mode is TCEN.	2.5V	4V	3V
Tint variable range	dPTIN	O-33	(1) Y-OFF	Adjust the relative phase of the SG's chroma and burst so that the B output assumes a horizontal waveform. (Tint VR : 2.5V) Set the tint VR at 5V and adjust the relative phase of the SG's chroma and burst so that the B-Y output assumes a horizontal waveform ; that phase amount is +ΔT. In the same manner, set the tint VR at 0V and obtain -ΔT.	2.5V	4V	1V ↑ 3V ↓ 5V
Demodulation output ratio	R/Bn	O-33 O-35	(2)	Adjust the relative phase of the SG's chroma and burst so that the B output is maximized and adjust the color VR so that the B output becomes 2Vp-p. And then adjust the relative phase of the SG's chroma and burst so that the R output is maximized and measure the R output's Vp-p. Calculate the ratio to 2Vp-p. (R/B)	Adjust	4V	3V
	G/Bn	O-33 O-34	(2)	In the same manner, calculate the demodulation output ratio between the G output at TP33 and the B output. (G/B)	Adjust	4V	3V
Demodulation angle	∠RBn	O-33 O-35	(2)	Adjust the relative phase of the SG's chroma and burst so that the B output becomes 0 at the demodulation output ratio R/B's color position. And then adjust the relative phase of the SG's chroma and burat so that the R output becomes 0 ; that phase amount is ∠RBn.	Adjust	4V	3V
	∠GBn	O-33 O-35	(2)	In the same manner as above, measure the G output and B output's demodulation angle ∠GBn.	Adjust	4V	3V

OSD block Input signals and test conditions

Set up the following conditions unless otherwise specified for each test item.
(VIF, SIF blocks : No signal)

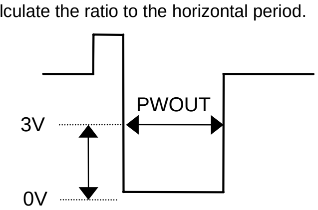
1. INT IN (pin 10) : No signal
2. EXT IN (pin 14) : Input signal color bar : 0dB (PAL)
3. S-CHROMA IN (pin 13) : DC-sharp + chroma signal
4. SW conditions : EXT VIDEO selected. SW36 shorted (SW36 : ON)
5. VR control position : Contrast VR - 4V, sharpness VR - 2V, others - control center
6. V_{CC}, I_{CC} conditions : V_{CC} = 7.8V, I_{CC} = 12mA
7. The OSD input waveform is such that :
   (1) a pulse signal of blanking period 0V and scanning period 0.7V is input
   (2) no signal
   (3) a 100mVp-p AC sweep (100kHz to 10MHz) of blanking interval 0V and scanning period 0.35V is input

Parameter	Symbol	Test point	Input signal	Test method	CONTRAST	BRIGHT VR	BLK IN
[OSD block]							
OSD input level	E OSD	O-33	(1)	Measure the DC voltage amplitude.	4V	2.5V	2V
OSD input DC voltage	V OSD	O-29B O-30B O-31B	(2)	Measure the DC voltage.	4V	2.5V	2V
F-BLK input threshold level	V_{28}TH	O-33	(2)	Raise the voltage at I-28 from 0.5V until the B output becomes OSD mode. Measure the voltage at I-28 at that moment.	4V	2.5V	Variable
OSD output pedestal difference	V OSD R V OSD G V OSD B	O-35 O-34 O-33	(2)	Measure the R, G, and B's DC voltage.	4V	2.5V	2V
OSD output max	E OSD R1 E OSD G1 E OSD B1	O-35 O-34 O-33	(1)	Measure the R, G, and B's DC voltage amplitude.	5V	2.5V	2V
OSD output min	E OSD R2 E OSD G2 E OSD B2	O-35 O-34 O-33	(1)	Measure the R, G, and B's DC voltage amplitude.	0V	2.5V	2V
OSD signal frequency characteristics	BW OSD	O-33	(3)	Measure the frequency at which the output level drops 3dB relative to that when f = 100kHz is set.	4V	2.5V	2V
TV-OSD crosstalk (C-Y)	C TTVR C TTVG C TTVB	O-35 O-34 O-33	(2)	Measure the R, G, B, AC voltage.	4V	2.5V	2V
OSD-TV crosstalk (C-Y)	C TOSDR C TOSDG C TOSDB	O-35 O-34 O-33	(3)	Measure the R, G, B, AC voltage.	4V	2.5V	0V
OSD CH between crosstalk (G-Y)	C TOSD	O-34	(3)	Measure the G AC voltage.	4V	2.5V	0V

Deflection block Input signals and test conditions

Set up the following conditions unless otherwise specified for each test item.
(VIF, SIF blocks : No signal)

1. EXT VIDEO IN : • Horizontal · vertical composite signal (1Vp-p, same as for video block, chroma block)
   (I-14A) • Horizontal sync signal only (0.5Vp-p, pulse width 4.7μs)
   • Open
2. SW conditions : All SW's turned off unless otherwise specified
3. V_{CC}, I_{CC} conditions : V_{CC} = 7.8V, I_{CC} = 12mA

Parameter	Symbol	Test point	Input signal	Test method	SW20	SW25
[Deflection block]						
Vertical free-running period	TV free 50	Z-20B	I-14A : No signal	With Z-21 connected to GND, measure the vertical output period at Z-20B and calculate the ratio to the horizontal period.	OFF	B
	TV free 60	Z-20B	I-14A : No signal	With 7.8V applied to Z-21, measure the vertical output period and calculate the ratio to the horizontal period.	OFF	B
Vertical sync maximum period	TV max50	Z-20B	I-14A : Horizontal sync signal	With Z-21 connected to GND, measure the vertical output period at Z-20B and calculate the ratio to the horizontal period.	OFF	B
	TV max60	Z-20B	I-14A : Horizontal sync signal	With 7.8V applied to Z-21, measure the vertical output period and calculate the ratio to the horizontal period.	OFF	B
Vertical sync minimum period	TV min50	Z-20B O-25	I-14A : Horizontal sync signal	Apply 8.5V and 0V to Z-27B and Z-21, respectively. Turn off SW20 and make adjustments so that the resistance between O-20 and GND becomes 4.7kΩ and then turn on SW20. Calculate the ratio between the vertical output period at Z-20B and the horizontal output period at O-25.	OFF ↓ ON	B
	TV min60	Z-20B O-25	I-14A : Horizontal sync signal	Apply 8.5V and 7.8V to Z-27B and Z-21, respectively. Make measurements in the same manner as for TV min 50.	OFF ↓ ON	B
Vertical blanking pulse peak value	VHVBL	O-32	I-14A : Horizontal · vertical sync signal	Measure the vertical blanking pulse peak value in the video output at O-32. (GND is assumed to be 0V.)	OFF	B
Vertical blanking pulse width	PW BLK50	O-32	I-14A : Horizontal sync signal	With Z-21 connected to GND, measure the vertical blanking pulse width in the video output at O-32 and calculate the ratio to the horizontal period.	OFF	B
	PW BLK60	O-32	I-14A : Horizontal sync signal	With 7.8V applied to Z-21, measure the vertical blanking pulse width in the video output at O-32 and calculate the ratio to the horizontal period.	OFF	B
Vertical output pulse width	PWVOUT	Z-20B	I-14A : Horizontal · vertical sync signal	Measure the vertical output width at Z-20B and calculate the ratio to the horizontal period. 	OFF	B

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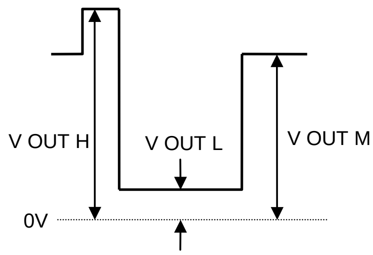
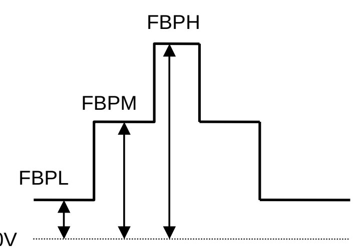
Parameter	Symbol	Test point	Input signal	Test method	SW20	SW25
Vertical output voltage	V OUT H V OUT M V OUT L	Z-20B	I-14A : Horizontal · vertical sync signal	Measure the voltage for each vertical output at Z-20B. 	OFF	
Vertical external trigger load resistance	R_{TR}	Z-20B O-20C	I-14A : Horizontal sync signal	Turn on SW20 and set V,VR to a maximum and then decrease slowly until the vertical output period becomes 225H. Turn off SW20 and measure the resistance between O-20C and GND.	ON ↓ OFF	B
Vertical automatic sync stop voltage	V_{SAS}	I-20A Z-22	I-14A : Horizontal · vertical sync signal	Use the vertical output at Z-20B to synchronize an oscilloscope and monitor the output waveform at Z-22. Connect a DC power supply to I-20A and raise the voltage slowly until the output waveform becomes larger. Measure the voltage at I-20A at that moment.	OFF	B
Horizontal AFC gate release voltage	V_{GS}	Z-22 Z-20A	I-14A : Horizontal sync signal	Connect a DC power supply to I-20A and set it at 0V. Monitor the AFC1 waveform at Z-22 and raise the supply voltage at Z-20A slowly until the AFC1 waveform for the vertical sync's equivalent pulse period changes. Measure the voltage at Z-20A at that moment.	OFF	B
Vertical output pulse start V_{CC} voltage	S_{VV}	Z-20B V_{CC}	I-14A : No signal (open)	Raise V_{CC} (pins 40, 44, and 45) from 0V slowly until a pulse signal appears in the vertical output at Z-20B. Measure V_{CC} at that moment.	OFF	B
Horizontal free-running frequency deviation	ΔfH	O-25	I-14A : No signal (open)	Connect a counter to O-25 (horizontal output) to measure the horizontal free-running frequency. Calculate the deviation from 15.680kHz.	OFF	B
Dependence of horizontal free-running frequency on V_{CC}	ΔfHV_{CC}	O-25	I-14A : No signal (open)	Connect a DC power supply to I_{CC} (horizontal pin 24 V_{CC}) and set it at 6.0V. And then measure the horizontal output frequency at TP14 and calculate the deviation from the horizontal free-running frequency.	OFF	B
Horizontal pull-in range	fHPULL	O-25 I-14A	I-14A : Horizontal sync signal	Monitor the horizontal sync signal and the horizontal output at O-25 using an oscilloscope and vary the horizontal sync signal frequency to measure the pull-in range.	OFF	B
Horizontal output pulse start V_{CC} voltage	S_{HV}	O-25 I_{CC}	I-14A : No signal (open)	Connect a DC power supply to I_{CC} (horizontal pin 24 V_{CC}) and raise it from 0V slowly until a pulse signal appears in the horizontal output at O-25. Measure the Icc pin voltage at that moment.	OFF	B
AFC2 FBP peak value	FBPH FBPM FBPL	Z-26B	I-14A : Horizontal sync signal	Measure the FBP peak value at Z-26B. 	OFF	B

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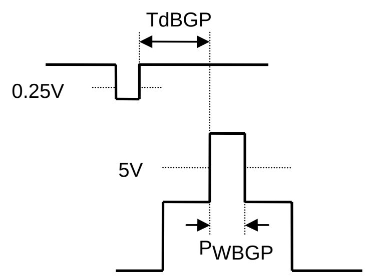
Parameter	Symbol	Test point	Input signal	Test method	SW20	SW25
Horizontal output pulse width	PWHOUT	O-25	I-14A : Horizontal sync signal	Measure the horizontal output pulse width at O-25.	OFF	B
Horizontal output pulse phase	H_{PF}	O-25 I-14A	I-14A : Horizontal sync signal	Measure the time from when the horizontal output pulse at O-25 rises until the horizontal sync signal at I-14A falls.	OFF	A
	H_{PCEN}	O-25 I-14A	I-14A : Horizontal sync signal	Measure the time from when the horizontal output pulse at O-25 rises until the horizontal sync signal at I-14A falls.	OFF	B
	H_{PR}	O-25 I-14A	I-14A : Horizontal sync signal	Measure the time from when the horizontal output pulse at O-25 rises until the horizontal sync signal at I-14A falls.	OFF	C
Burst gate pulse width	P_{WBGP}	Z-26B I-14A	I-14A : Horizontal vertical sync signal	Measure the burst gate level width at Z-26B. 	OFF	B
Burst gate pulse phase	T_{dBGP}	Z-26B I-14A	I-14A : Horizontal vertical sync signal	Measure the delay time from when the horizontal output pulse at I-14A rises until the burst gate pulse at Z-26B falls.	OFF	B
50/60 output voltage	V_{50}	Z-21	I-14A : No signal	Connect Z-21 to GND once and then bring it into open state. And then measure the voltage at Z-21.	OFF	B
	V_{60}	Z-21	I-14A : No signal	Pull Z-21 up to V_{CC} once and then bring it into open state. And then measure the voltage.	OFF	B
50/60 input voltage	$V_{IN}50$	Z-21	I-14A : No signal	With 7.8V applied to Z-21, monitor the frequency at Z-20B. Lower the voltage at Z-21 slowly until the frequency at Z-20B changes from 60Hz to 50Hz. Measure the voltage at Z-21 at that moment.	OFF	B
	$V_{IN}60$	Z-21	I-14A : No signal	With 0V applied to Z-21, monitor the frequency at Z-20B. Raise the voltage at Z-21 slowly until the frequency at Z-20B changes from 50Hz to 60Hz. Measure the voltage at Z-21 at that moment.	OFF	B
SECAM V pulse peak value	S_{VH}	Z-26B	I-14A : No signal	Measure the peak value for the V period at Z-26B.	OFF	B
SECAM V pulse width	S_{VW}	Z-26B	I-14A : No signal	Measure the width for the V period at Z-26B.	OFF	B

This catalog provides information as of October, 2005. Specifications and information herein are subject to change without notice.