AN3501NFBP

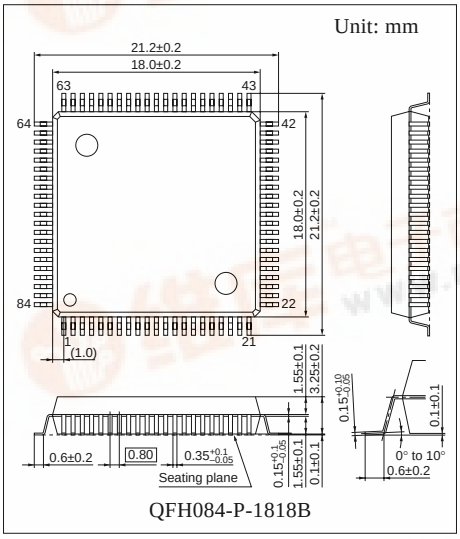
Luminance, chroma and linear audio signal processing IC for VCR

■ Overview

The AN3501NFBP is a luminance, chroma signal processing IC for VCR (PAL and NTSC). It also integrates a playback equalizer and an NTSC playback circuit.

A normal audio signal recording/playback circuit is added so as to design a signal processing PCB in common for both a HiFi and a normal model, resulting in space saving of equipment.

This IC is a completely adjustment-free device which has been realized by introducing a adjustment-free technology such as a Zener zap, and contributes to a more efficient design/development and production of an equipment.



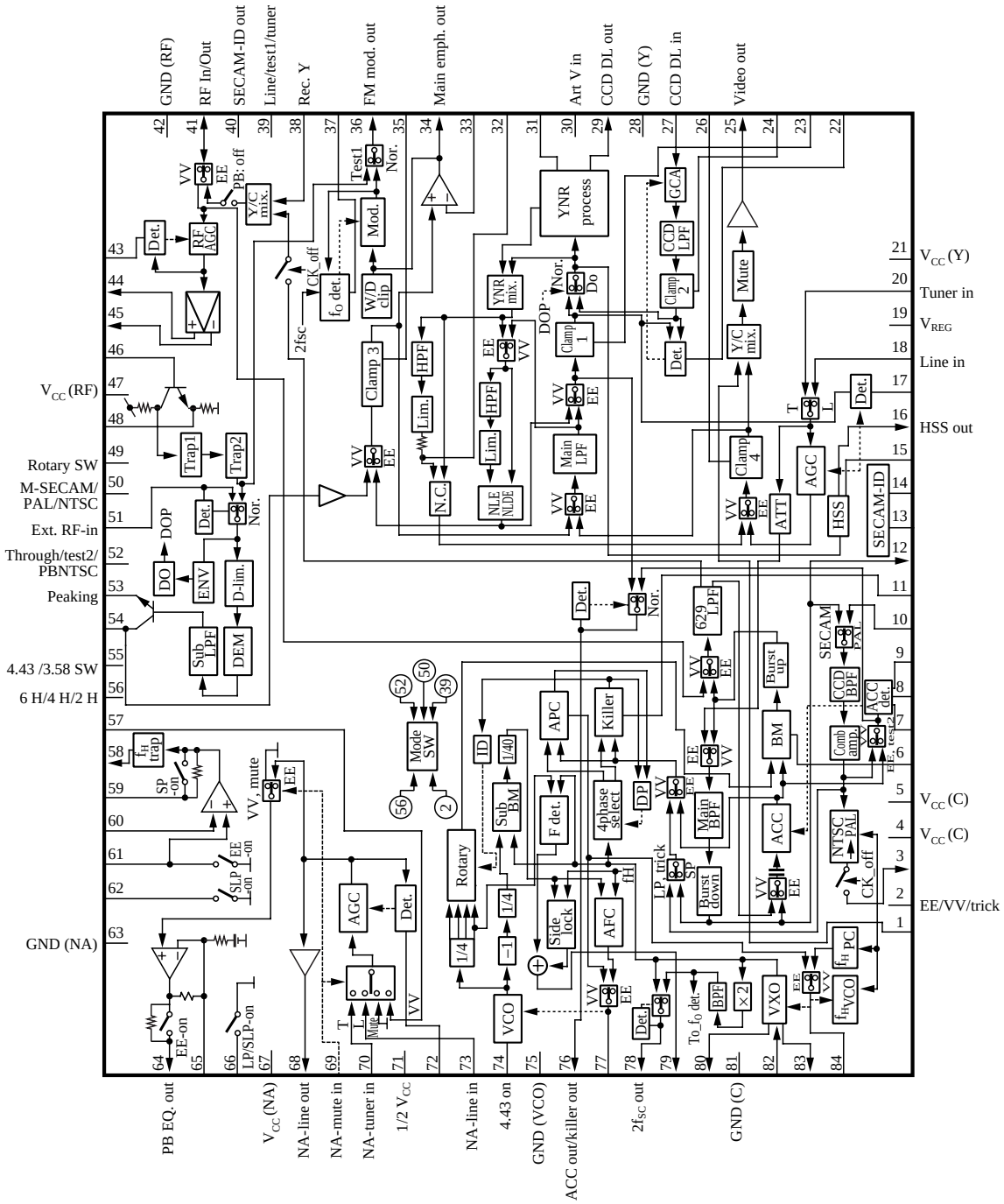
■ Features

- Supply voltage range 4.8 V to 5.2 V (600 mW typ.)
  - Usable for 4.43 MHz/3.58 MHz systems
  - 4.43 MHz system: PAL/NTSC/ME-SECAM
  - 3.58 MHz system: NTSC/PAL-N
- Adjustment-free
  - Video output level (recording mode)
  - Video output level (playback mode)
  - White clip level
  - f_O frequency: sync. tip frequency
  - FM deviation
  - FM level (recording mode)
  - Chroma level (recording mode)
- Normal audio circuit built in
- NTSC to PAL conversion by adopting a simplified NTSC playback circuit of a line skip method.
- ME-SECAM discrimination circuit built-in
- All filters built-in, including a CCD filter
- The upper part flicker suppression by adoption of an ACC circuit by the field and an adaptive APC circuit

■ Applications

- VCR, camera recorder, combined CTV/VCR set

■ Block Diagram



■ Pin Descriptions

Pin No.	Description	Pin No.	Description
1	Y/C mix. chroma input pin	38	Rec. Y-mix. in
2	EE/VV/trick changeover	39	Line/test1/tuner changeover
3	PB chroma output	40	SECAM-ID out
4	Chroma $V_{CC(1)}$	41	RF In/Out
5	Chroma $V_{CC(2)}$	42	RF GND
6	BM DC det.	43	RF AGC det./EE edit high
7	ACC det.	44	Phase shift pos.
8	F. ACC det. (ROT: high)	45	Phase shift neg.
9	F. ACC det. (ROT: low)	46	Phase shift in
10	C comb filter input	47	RF V_{CC}
11	Killer det.	48	RF EQ. peaking/SQPB high
12	C comb filter output	49	Rotary in
13	SECAM det. 1	50	M-SECAM/PAL/NTSC changeover
14	SECAM det. 2	51	Ext. RF in
15	Sync. sepa. det.	52	Through/test2/PBNTSC changeover
16	HSS out	53	Peaking
17	AGC det.	54	Main de-emphasis
18	Line in	55	4.43 MHz/3.58 MHz changeover
19	V_{REG} (2.0 V)	56	SLP/LP/SP changeover
20	Tuner in	57	NA-PB amp. in
21	Lumi. V_{CC}	58	NA-PB EQ. out
22	CCD AGC det.	59	NA-PB EQ. SW
23	Sub clamp det. 1	60	NA-PB NF
24	Sub clamp det. 2	61	NA-PB in
25	Video out	62	NA-PB in EQ./SLP
26	Sub clamp det. 4	63	NA GND
27	CCD DL in	64	NA-rec. out
28	Lumi. GND	65	NA-rec. EQ. NF
29	CCD DL out	66	NA-rec. EQ. LP/SLP
30	Quasi-sync. pulse input	67	NA V_{CC}
31	YNR lim. DC	68	NA-line out
32	N.C. LPF	69	NA-mute in
33	Main emph. FB in/VV edit high	70	NA-tuner in
34	Main emph. out	71	1/2 V_{CC}
35	Sub clamp det. 3	72	NA-AGC det.
36	FM mod. out	73	NA-line in
37	f_O det.	74	VCO f_O

■ Pin Descriptions (cntinued)

Pin No.	Description	Pin No.	Description
75	VCO GND	80	XO/VCXO out
76	ACC out/killer out	81	C GND
77	Rec. AFC/PB APC det.	82	XO/VCXO in
78	$2f_{SC}$ out	83	XO/VCXO out
79	Side lock det.	84	Rec. APC/f_H AFC det.

■ Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Supply voltage	V_{CC}	5.5	V
Supply current	I_{CC}	175	mA
Power dissipation *2	P_D	660	mW
Operating ambient temperature *1	T_{opr}	–20 to +70	°C
Storage temperature *1	T_{stg}	–25 to +125	°C

Note) 1. *1: Except for the operating ambient temperature and storage temperature, all ratings are for T_a = 25°C.
*2: The power dissipation shown is for the IC package at T_a = 70°C

■ Recommended Operating Range

Parameter	Symbol	Range	Unit
Supply voltage	V_{CC}	4.8 to 5.2	V

■ Electrical Characteristics at V_{CC} = 5 V, T_a = 25°C

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
DC characteristics						
Supply current (EE)	I_{CCR}	V_{CC} = 5 V, EE mode	92	117	144	mA
Supply current (VV)	I_{CCP}	V_{CC} = 5 V, VV mode	105	133	164	mA
High mode hold voltage	V_H	Pin 2, pin 39, pin 50, pin 52, pin 56	3.5	—	5.0	V
Middle mode hold voltage	V_M	Pin 2, pin 39, pin 50, pin 52, pin 56	1.75	—	3.0	V
Low mode hold voltage	V_L	Pin 2, pin 39, pin 50, pin 52, pin 56	0	—	1.25	V
Sync. level insertion mode hold voltage	V_{30H}		3.5	—	5.0	V
Gray level insertion mode hold voltage	V_{30M}		1.5	—	3.0	V
Through mode hold voltage	V_{30L}		0	—	1.0	V
Rotary SWH hold voltage	V_{49H}		3.5	—	5.0	V
Rotary SWL hold voltage	V_{49L}		0	—	1.25	V
4.43 MHz mode hold voltage	V_{55H}		1.75	—	5.0	V
3.58 MHz mode hold voltage	V_{55L}		0	—	1.25	V

■ Electrical Characteristics at V_{CC} = 5 V, T_a = 25°C (continued)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
DC characteristics (continued)						
Audio mute hold voltage	V_{69H}		3.5	—	5.0	V
Audio through hold voltage	V_{69L}		0	—	1.25	V
After-recording mode hold voltage	V_{70H}		4.0	—	5.0	V
Insertion mode hold voltage	V_{70L}		0	—	1.0	V
VV edit mode hold voltage	V_{33H}		4.0	—	5.0	V
EE edit mode hold voltage	V_{43H}		4.0	—	5.0	V
SQPB mode hold voltage	V_{48H}		3.25	—	5.0	V
Luminance recording system						
AGC characteristics	$\Delta V_{18\text{-}25}$	White 100%, V_{IN} = [2.0 V[p-p]]/[0.5 V[p-p]]	– 0.5	0.5	1.0	dB
EE out amplitude (PAL)	$V_{20\text{-}25P}$	White 100%, V: S = 7: 3, V_{IN} = 1 V[p-p]	1.995	2.1	2.205	V[p-p]
AGC frequency characteristics	$f_{20\text{-}25}$	f_{IN} = 5 MHz/1 MHz	–2.0	– 0.5	0.5	dB
AGC output level ratio	$\Delta V_{20\text{-}25}$	White 140%, 1.28 V[p-p], Ratio to $V_{20\text{-}25P}$	0.05	0.55	1.25	dB
EE out amplitude (NTSC)	$V_{20\text{-}25N}$	White 100%, V = 0.714 V[p-p], V_{IN} = 1 V[p-p]	1.9	2.1	2.3	V[p-p]
M LPF frequency characteristics 1	$f_{18\text{-}76(1)}$	4.43 MHz mode, V_{IN} = 100 mV[p-p] f_{IN} = 2 MHz/0.15 MHz	–1.7	0.1	0.9	dB
M LPF frequency characteristics 2	$f_{18\text{-}76(2)}$	4.43 MHz mode, V_{IN} = 100 mV[p-p] f_{IN} = 3 MHz/0.15 MHz	–4.2	–2.2	–0.7	dB
M LPF frequency characteristics 3	$f_{18\text{-}76(3)}$	4.43 MHz mode, V_{IN} = 100 mV[p-p] f_{IN} = 4.43 MHz/0.15 MHz	—	–35	–30	dB
M LPF frequency characteristics 4	$f_{18\text{-}76(4)}$	3.58 MHz mode, V_{IN} = 100 mV[p-p] f_{IN} = 2.2 MHz/0.15 MHz	–4.8	–1.8	0.2	dB
M LPF frequency characteristics 5	$f_{18\text{-}76(5)}$	3.58 MHz mode, V_{IN} = 100 mV[p-p] f_{IN} = 3.58 MHz/0.15 MHz	—	–39	–27	dB
Sync. separation minimum input sensitivity	S_{16}	White 100%, V_{IN} = 0.145 V[p-p], Pin 76 amplitude	23	30	37	%
Sync. separation output pulse front-edge delay	T_{16}	White 100%, V_{IN} = 1.0 V[p-p], including LPF	1.14	1.34	1.54	µs
Sync. separation low-level output pulse	V_{16L}	R_L (V_{CC}) = 10 kΩ	—	—	0.7	V
Sync. separation high-level output pulse	V_{16H}	R_L (GND) = 22 kΩ	4.5	—	—	V
Vertical emph. 1-K value gain 1	$G_{76\text{-}29(1)}$	V_{76} = 400 mV[p-p], LP, f_{IN} = 150 kHz	–3.0	–1.5	0	dB
Vertical emph. 1-K value gain 2	$G_{76\text{-}29(2)}$	V_{76} = 400 mV[p-p], LP, f_{IN} = 2 MHz	–1.5	0	1.5	dB
Vertical emph. difference signal amplitude	ΔV_{VE}	White 100%, 1 V[p-p]	—	30	100	mV[p-p]

■ Electrical Characteristics at V_{CC} = 5 V, T_a = 25°C (continued)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Luminance recording system (continued)						
Vertical emph. X value gain	$G_{31\text{-}33}$	V_{IN} = 40 mV[p-p], f_{IN} = 150 kHz	–18.5	–15.0	–11.5	dB
CCD input output level	V_{29}	V_{IN} = 1 V[p-p], white 100%	375	405	440	mV[p-p]
NL emphasis/detail enhancer frequency characteristics 1	$G_{NE(1)}$	SP/edit: V_{76} = –20 dB, f_{IN} = 500 kHz/150 kHz	0.4	1.2	2.0	dB
NL emphasis/detail enhancer frequency characteristics 2	$G_{NE(2)}$	SP/edit: V_{76} = –20 dB, f_{IN} = 2 MHz/150 kHz	1.7	2.9	4.1	dB
NL emphasis/detail enhancer frequency characteristics 3	$G_{NE(3)}$	SP/normal: V_{76} = –20 dB, f_{IN} = 500 kHz/150 kHz	1.1	2.1	3.1	dB
NL emphasis/detail enhancer frequency characteristics 4	$G_{NE(4)}$	SP/normal: V_{76} = –20 dB, f_{IN} = 2 MHz/150 kHz	3.2	4.7	6.2	dB
NL emphasis/detail enhancer frequency characteristics 5	$G_{NE(5)}$	LP: V_{76} = –20 dB, f_{IN} = 500 kHz/150 kHz	2.54	3.84	5.14	dB
NL emphasis/detail enhancer frequency characteristics 6	$G_{NE(6)}$	LP: V_{76} = –20 dB, f_{IN} = 2 MHz/150 kHz	3.9	5.9	7.9	dB
NL emphasis/detail enhancer frequency characteristics 7	$G_{NE(7)}$	LP: V_{76} = 0 dB, f_{IN} = 2 MHz/150 kHz	0.2	0.9	1.6	dB
Main emphasis gain	G_{ME}	1 kΩ/220+0.1 μF, f_{IN} = 150 kHz	13	15	17	dB
Main emphasis standard output level	V_{ME}	White 100%, 1 V[p-p]	350	400	450	mV[p-p]
White clip level	LV_{WC}	White 100%	176	183	190	%
Dark clip level	LV_{DC}	White 100%	43	55	65	%
FM mod. output frequency (4.43 PAL)	f_{36P}	No input 4.43 MHz mode, PAL mode	3.75	3.81	3.85	MHz
FM mod. output frequency (4.43 NTSC)	$f_{36N(1)}$	No input 4.43 MHz mode, NTSC mode	3.37	3.47	3.57	MHz
FM mod. output frequency (3.58 NTSC)	$f_{36N(2)}$	No input 3.58 MHz mode, NTSC mode	3.29	3.39	3.49	MHz
FM mod. output secondary distortion (PAL)	$2f_{36P}$	No input PAL mode	—	–45	–35	dB
FM mod. deviation (PAL)	D_{36P}	White 100%	0.95	1.0	1.05	MHz
FM mod. deviation (NTSC)	D_{36N}	White 100%	0.9	1.0	1.1	MHz
Rec. FM total output amplitude (PAL)	V_{FM}	V_{36} /4 × $G_{38\text{-}41}$, V_{36}: pin 36 amplitude	332.5	350	367.5	mV[p-p]
Rec. FM amp. frequency characteristics	$f_{38\text{-}41}$	10 MHz/4 MHz	–2.5	– 0.5	0.5	dB
Luminance playback system						
FM demodulation sensitivity (VHS)	ΔV_{53V}	Pin 51 input, f_{IN} = 3.8 MHz, 4.8 MHz	0.13	0.175	0.22	V/MHz
FM demodulation sensitivity (SQPB)	ΔV_{53S}	Pin 51 input, f_{IN} = 5.4 MHz, 7.0 MHz	0.13	0.175	0.22	V/MHz

■ Electrical Characteristics at V_{CC} = 5 V, T_a = 25°C (continued)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Luminance playback system (continued)						
PB output amplitude	V_{PB}	Pin 51 input, f_{IN} = 3.8 MHz, 4.8 MHz	1.995	2.1	2.205	V[p-p]
Drop out detect SW on level	S_{51}	f_{IN} = 4 MHz, 0 dB = 350 mV[p-p]	–22	–18	–14	dB
Drop out detect hysteresis	ΔS_{51}	f_{IN} = 4 MHz, 0 dB = 350 mV[p-p]	1.0	3.0	5.0	dB
Env. detect SW operating time	T_{ENV}	AM wave 1 kHz, V_{IN} = 350 mV, f_{IN} = 4 MHz	180	224	270	µs
NL de-emphasis frequency characteristics 1	$G_{ND(1)}$	SP: V_{IN} = –20 dB, f_{IN} = 500 kHz/150 kHz	–2.7	–1.7	– 0.7	dB
NL de-emphasis frequency characteristics 2	$G_{ND(2)}$	SP: V_{IN} = –20 dB, 2 MHz/150 kHz	–5.5	–4.2	–3.0	dB
NL de-emphasis frequency characteristics 3	$G_{ND(3)}$	LP: V_{IN} = –20 dB, f_{IN} = 500 kHz/150 kHz	–6.2	–3.9	–2.2	dB
NL de-emphasis frequency characteristics 4	$G_{ND(4)}$	LP: V_{IN} = –20 dB, 2 MHz/150 kHz	–9.0	–7.5	–6.2	dB
NL de-emphasis frequency characteristics 5	$G_{ND(5)}$	LP: V_{IN} = 0 dB, 2 MHz/150 kHz	–2.7	–2.0	–1.3	dB
YNR 1-K value gain EDNC	$G_{54\text{-}29E}$	White 100%, V_{IN} = 160 mV[p-p]	4.5	6.0	7.5	dB
YNR 1-K value gain VNC	$G_{54\text{-}29V}$	White 100%, V_{IN} = 160 mV[p-p]	1.8	3.3	4.8	dB
YNR difference element amplitude EDNC	ΔV_{EDNC}	Rectangular wave, V_{IN} = 160 mV[p-p]	—	30	100	mV[p-p]
YNR difference element amplitude VNC	ΔV_{VNC}	Rectangular wave, V_{IN} = 160 mV[p-p]	—	10	100	mV[p-p]
YNR X value gain EDNC	$G_{31\text{-}25E}$	V_{IN} = 40 mV[p-p], f_{IN} = 150 kHz	–4.9	–2.9	–1.3	dB
YNR X value gain VNC	$G_{31\text{-}25V}$	V_{IN} = 40 mV[p-p], f_{IN} = 150 kHz	0.6	2.1	3.6	dB
YNR lim. (VNC) output level 1	$V_{25YL(1)}$	V_{IN} = 800 mV[p-p], f_{IN} = 150 kHz	26	40	53	mV[p-p]
YNR lim. (VNC) output level 2	$V_{25YL(2)}$	V_{IN} = 300 mV[p-p], f_{IN} = 150 kHz	13.5	25.0	37.0	mV[p-p]
YNR lim. (VNC) output level 3	$V_{25YL(3)}$	V_{IN} = 100 mV[p-p], f_{IN} = 150 kHz	80	110	140	mV[p-p]
CCD AGC cover range	ΔV_{31}	V_{54} = 160 mV[p-p], rectangular wave, CCD Gain ±3 dB	0	30	100	mV[p-p]
Noise cancellar frequency characteristics 1	$G_{25N(1)}$	Normal mode, V_{27} = –30 dB, Including CCD LPF, f_{IN} = 1 MHz/150 kHz	–13.0	–8.0	–4.8	dB
Noise cancellar frequency characteristics 2	$G_{25N(2)}$	Normal mode, V_{27} = –30 dB, Including CCD LPF, f_{IN} = 2 MHz/150 kHz	–9.3	–4.5	–2.3	dB
Noise cancellar frequency characteristics 3	$G_{25N(3)}$	Normal mode, V_{27} = 0 dB, Including CCD LPF, f_{IN} = 2 MHz/150 kHz	– 0.8	1.2	2.7	dB
Noise cancellar frequency characteristics 4	$G_{25N(4)}$	Edit mode, V_{27} = –30 dB, Including CCD LPF, f_{IN} = 2 MHz/150 kHz	– 0.3	–1.0	0.5	dB
Video output sync. DC level	ΔV_{SYNC}	White 100%, V_{27} = 317 mV[p-p]	0.8	0.95	1.1	V
Video output quasi-V offset voltage	ΔV_{25A}	V_{30} = 5 V	–30	0	60	mV
Video output quasi-H offset voltage	ΔV_{25G}	V_{30} = 2.5 V	0.85	1.0	1.15	V

■ Electrical Characteristics at V_{CC} = 5 V, T_a = 25°C (continued)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Luminance playback system (continued)						
Chroma mix. output gain	G_{1-25}	V_{IN} = 600 mV[p-p], f_{IN} = 5 MHz	4.9	6.6	8.3	dB
Chroma mix. frequency characteristics	f_{1-25}	V_{IN} = 600 mV[p-p], f_{IN} = 5 MHz/1 MHz	– 0.5	0.3	1.0	dB
RF-AGC output amplitude	V_{41-45}	V_{IN} = 200 mV[p-p], f = 4 MHz	170	215	265	mV[p-p]
RF-AGC sensitivity	S_{RF}	±6 dB input	—	0.5	3.0	dB
RF-AGC output distortion	D_{RF}	V_{IN} = 400 mV[p-p], f = 4 MHz	—	–44	–35	dB
RF-AGC maximum gain	G_{RFAGC}	V_{IN} = 20 mV[p-p], f = 4 MHz	8.5	10.5	12.5	dB
RF-EQ. frequency characteristics 2	GEQ2	V_{IN} = 20 mV[p-p], f = 1 MHz/5 MHz	–24.0	–15.0	–9.0	dB
RF-EQ. frequency characteristics 3	GEQ3	f = 2 MHz/5 MHz	–9.8	–5.3	–3.3	dB
RF-EQ. frequency characteristics 4	GEQ4	f = 630 kHz/5 MHz	—	–30	–15	dB
RF-EQ. frequency characteristics 5	GEQ5	f = 8 MHz/5 MHz	—	–30	–15	dB
RF-EQ. total characteristics	V_{41-36}	V_{IN} = 200 mV[p-p]	305	435	605	mV[p-p]
Chroma recording system						
Output DC for color	V_{76CO}	Color, V_{11} = 3.5 V	3.5	—	—	V
Output DC for killer	V_{76CK}	Killer, V_{11} = 1.5 V	—	—	0.5	V
Burst up gain	G_{BUP}	V_{IN} = 1: 1 (B = 300 mV[p-p])	5	6	7	dB
Rec. APC pull in range 1	$f_{APC(1)}$	4.43 MHz mode, $f_{IN} = f_{SC}$ +500 Hz	500	800	—	Hz
Rec. APC pull in range 2	$f_{APC(2)}$	4.43 MHz mode, $f_{IN} = f_{SC}$ –500 Hz	—	–800	–500	Hz
Rec. APC pull in range 3	$f_{APC(3)}$	3.58 MHz mode, $f_{IN} = f_{SC}$ +500 Hz	500	800	—	Hz
Rec. APC pull in range 4	$f_{APC(4)}$	3.58 MHz mode, $f_{IN} = f_{SC}$ –500 Hz	—	–800	–500	Hz
VXO free-run frequency 1	$f_{VXO(1)}$	4.43 MHz mode, SECAM mode	–100	0	100	Hz
VXO free-run frequency 2	$f_{VXO(2)}$	3.58 MHz mode, SECAM mode	–100	0	100	Hz
Rec. chroma output amplitude	V_{CR}	B: C = 1: 2 chroma level	75.6	82	88.4	mV[p-p]
ACC characteristics 1	ΔV_{ACC1}	V_{IN} = 1: 1, +9, –5 dB, V_{49} = 5 V	—	—	3	dB
ACC characteristics 2	ΔV_{ACC2}	V_{IN} = 1: 1, +9, –5 dB, V_{49} = 0 V	—	—	3	dB
630k LPF frequency characteristics 1	$f_{RL(1)}$	4.43 MHz mode, V_{IN} = 200 mV[p-p], 150 kHz/630 kHz	– 0.7	0.3	1.3	dB
630k LPF frequency characteristics 2	$f_{RL(2)}$	4.43 MHz mode, V_{IN} = 200 mV[p-p], 3 MHz/630 kHz	—	–25	–15	dB
630k LPF frequency characteristics 3	$f_{RL(3)}$	4.43 MHz mode, V_{IN} = 200 mV[p-p], 4.43 MHz/630 kHz	—	–35	–20	dB
630k LPF group delay	GD_{RL}	4.43 MHz mode, V_{IN} = 200 mV[p-p], f_{IN} = 630 kHz	310	360	410	ns
630k LPF frequency characteristics 4	$f_{RL(4)}$	3.58 MHz mode, V_{IN} = 200 mV[p-p], 2 MHz/630 kHz	–2.0	0	2.0	dB
SECAM discrimination output DC 1	$V_{40(1)}$	4.43 MHz mode, PAL mode, f_{IN} = 4.43 MHz	0	—	0.65	V
SECAM discrimination output DC 2	$V_{40(2)}$	4.43 MHz mode, SECAM mode, f_{IN} = 4.25 MHz, 4.41 MHz	4	—	5	V

■ Electrical Characteristics at V_{CC} = 5 V, T_a = 25°C (continued)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Chroma playback system						
Comb amp. gain SP	G_{MB}	SP mode, f_{SC} = 4.43 MHz	1.3	3.3	5.3	dB
Comb amp. gain LP	ΔG_{MB}	Difference from EP mode and SP mode	0.6	1.6	2.6	dB
Burst down gain 1	$G_{BD(1)}$	V_{IN} = 1: 1 (B = 440 mV[p-p]), NTSC/SP mode	–6.2	–5.2	–4.2	dB
Main BM carrier leak	G_{CL}	V_{IN} = 250 mV[p-p], f_{IN} = 630 kHz without signal	—	–45	–38	dB
Main BM signal leak	G_{SL}	V_{IN} = 250 mV[p-p], f_{IN} = 630 kHz	—	–55	–38	dB
XO free-run frequency 1	$f_{XO(1)}$	4.43 MHz mode, 1/2 × f_{78}	–50	—	50	Hz
XO free-run frequency 2	$f_{XO(2)}$	3.58 MHz mode, 1/2 × f_{78}	–50	—	50	Hz
$2f_{SC}$ output level 1	$V_{2fsc(1)}$	4.43 MHz mode	240	370	500	mV[p-p]
$2f_{SC}$ output level 2	$V_{2fsc(2)}$	3.58 MHz mode	260	400	540	mV[p-p]
f_{SC} output level 1	$V_{fsc(1)}$	4.43 MHz mode	300	370	500	mV[p-p]
f_{SC} output level 2	$V_{fsc(2)}$	3.58 MHz mode	300	420	560	mV[p-p]
630 k BPF gain 1	$G_{PB(1)}$	4.43 MHz mode, V_{IN} = 10 mV[p-p], f_{IN} = 630 kHz	25	30	35	dB
630k BPF frequency characteristics 1	$f_{PB(1)}$	4.43 MHz mode, V_{IN} = 10 mV[p-p], f_{IN} = 150 kHz/630 kHz	–5.0	–2.0	– 0.5	dB
630k BPF frequency characteristics 2	$f_{PB(2)}$	4.43 MHz mode, V_{IN} = 10 mV[p-p], f_{IN} = 930 kHz/630 kHz	–4	–2.0	– 0.5	dB
630k BPF frequency characteristics 3	$f_{PB(3)}$	4.43 MHz mode, V_{IN} = 10 mV[p-p], f_{IN} = 2.4 MHz/630 kHz	—	–40	–30	dB
630k BPF gain 2	$G_{PB(2)}$	3.58 MHz mode, f_{IN} = 630 kHz, Difference from 4.43 MHz mode	–1.0	0	1.0	dB
630k BPF frequency characteristics 4	$f_{PB(4)}$	3.58 MHz mode, f_{IN} = 930 kHz, Difference from 4.43 MHz mode	–2.0	0	2.0	dB
f_{HVCO} pull-in range	f_{VCOmax}	f_{IN} = f_H +500 Hz	500	—	—	Hz
	f_{VCOmin}	f_{IN} = f_H –500 Hz	—	—	–500	
SECAM discrimination output DC 3	$V_{40(3)}$	4.43 MHz mode, SECAM mode, f_{IN} = 0.63 MHz	0	—	0.65	V
SECAM discrimination output DC 4	$V_{40(4)}$	4.43 MHz mode, PAL mode, f_{IN} = 0.63 MHz, 0.65 MHz	0	—	0.65	V
SECAM discrimination output DC 5	$V_{40(5)}$	4.43 MHz mode, SECAM mode, f_{IN} = 0.67 MHz, 0.81 MHz	4	—	5	V
SECAM discrimination output DC 6	$V_{40(6)}$	4.43 MHz mode, PAL mode, f_{IN} = 0.65 MHz, 0.81 MHz	4	—	5	V
Audio-system						
Line out gain	V_{EL}	f = 1 kHz, EE, –29 dBV	22.4	23.6	24.8	dB
Rec. out level ratio at SP	V_{ER1}	f = 1 kHz, EE, –29 dBV, ratio to VEL	– 0.2	0.8	1.8	dB
Rec. out level ratio at SLP	V_{ER2}	f = 1 kHz, EE, –29 dBV, ratio to SP	– 0.2	0.3	0.8	dB

■ Electrical Characteristics at T_a = 25°C (continued)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Audio-system (continued)						
Rec. out distortion at LP	T_{ER1}	f = 1 kHz, EE, –29 dBV	—	0.3	1	%
Rec. out SN SLP	N_{ER2}	EE	—	–65	–59	dBV
AGC level ratio	V_{ELA}	f = 1 kHz, –9 dBV	—	0.3	3	dB
Line out distortion	T_{EL}	f = 1 kHz, –29 dBV	—	0.3	1	%
Rec. out max. level	V_{ERMAX}	f = 1 kHz, amplitude for distortion = 1%	– 0.5	—	—	dBV
PB gain SP	V_{VL1}	f = 1 kHz, –68.3 dBV	61	62	63	dB
PB level ratio SLP	V_{VL2}	f = 1 kHz, –70.8 dBV	—	2	—	dB
PB distortion SLP	T_{VL2}	f = 1 kHz, –70.8 dBV	—	0.5	1	%
Noise referred to input: SP	N_{VL1}	No input signal, R_g = 1.5 kΩ	—	—	1.8	μV[rms]
f_H attenuation	V_{TR1}	f = 15.625 kHz	—	–15	–5	dB
Line out max. level	V_{LMAX}	f = 1 kHz, amplitude for distortion = 1%	–1.5	—	—	dBV
Mute attenuation	V_{ML}	f = 1 kHz, PB mode	—	—	–80	dB

• Design reference data

Note) The characteristics listed below are theoretical values based on the IC design and are not guaranteed.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Luminance-system						
M LPF group delay 1	GD(1)	4.43 MHz mode, rec., f_{IN} = 0.15 MHz	655	705	755	ns
M LPF group delay 2	GD(2)	3.58 MHz mode, rec., f_{IN} = 0.15 MHz	670	750	830	ns
M LPF group delay difference	ΔGD	4.43 MHz mode, PB, f_{IN} = 1 MHz, SQPB/VHS mode difference	155	180	225	ns
CCD LPF frequency characteristics 1	$G_{27\text{-}29(1)}$	4.43 MHz mode, EDNC, V_{IN} = 312 mV[p-p], f_{IN} = 3 MHz/0.2 MHz	–2.0	0.5	1.5	dB
CCD LPF frequency characteristics 2	$G_{27\text{-}29(2)}$	4.43 MHz mode, EDNC, V_{IN} = 312 mV[p-p], f_{IN} = 13.3 MHz/0.2 MHz	—	–30	–25	dB
CCD LPF group delay 1	$GD_{29(1)}$	4.43 MHz mode, EDNC, V_{IN} = 312 mV[p-p], f_{IN} = 0.2 MHz	90	120	150	ns
CCD LPF frequency characteristics 3	$G_{27\text{-}29(3)}$	3.58 MHz mode, EDNC, V_{IN} = 312 mV[p-p], f_{IN} = 2 MHz/0.2 MHz	–3.0	0.7	2.0	dB
CCD LPF frequency characteristics 4	$G_{27\text{-}29(4)}$	3.58 MHz mode, EDNC, V_{IN} = 312 mV[p-p], f_{IN} = 7.2 MHz/0.2 MHz	—	–2.5	–20	dB
CCD LPF group delay 2	$GD_{29(2)}$	3.58 MHz mode, EDNC, V_{IN} = 312 mV[p-p], f_{IN} = 0.2 MHz	85	125	165	ns
FM carrier interleave	CI_{36}	EP mode, V_{37}: fixed	6.4	7.9	9.4	kHz
FM demod min. input level	V_{51MIN}	f_{IN} = 3.8 MHz, 4.8 MHz	10	—	—	mV[p-p]
FM demod linearity	L_{53V}	f_{IN} = 3 MHz, 4 MHz, 5 MHz	0.82	0.92	1.05	—
Sub LPF frequency characteristics 1	G_{SL1}	f_{IN} = 2 MHz/1.5 MHz, f_{OUT} = 4 MHz/3 MHz	–2.7	– 0.5	1.0	dB
Sub LPF frequency characteristics 2	G_{SL2}	f_{IN} = 3 MHz/1.5 MHz, f_{OUT} = 6 MHz/3 MHz	–16.5	–12.0	-8.4	dB

■ Electrical Characteristics at T_a = 25°C (continued)

• Design reference data (continued)

Note) The characteristics listed below are theoretical values based on the IC design and are not guaranteed.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Luminance-system (continued)						
DOC SW crosstalk	$CT_{25\text{-}54}$	V_{IN} = 160 mV[p-p], 1 MHz forced DOC	—	—	–40	dB
YNR lim. (VNC) output level 4	V_{25YL4}	V_{IN} = 300 mV[p-p], f_{IN} = 1 MHz	15	30	45	mV[p-p]
White noise compression level	V_{25WNS}	Trick mode, 3.8 MHz, 5.8 MHz	2.2	2.9	3.3	V[p-p]
Tune/line crosstalk	$CT_{20\text{-}18}$	f = 1 MHz	—	—	–40	dB
Line/tuner crosstalk	$CT_{18\text{-}20}$	f = 1 MHz	—	—	–40	dB
Chroma-system						
M BPF [4.43 MHz] frequency characteristics rec. 1	$f_{MR(1)\text{-}4}$	4.43 MHz mode, f_{IN} = 2.3 MHz/4.43 MHz	—	—	–15	dB
M BPF [4.43 MHz] frequency characteristics rec. 2	$f_{MR(2)\text{-}4}$	4.43 MHz mode, f_{IN} = 3.93 MHz/4.43 MHz	–3.5	–2.0	– 0.5	dB
M BPF [4.43 MHz] frequency characteristics rec. 3	$f_{MR(3)\text{-}4}$	4.43 MHz mode, f_{IN} = 4.93 MHz/4.43 MHz	–2.7	–1.2	0.6	dB
M BPF [4.43 MHz] frequency characteristics rec. 4	$f_{MR(4)\text{-}4}$	4.43 MHz mode, f_{IN} = 6.5 MHz/4.43 MHz	—	—	–10	dB
M BPF [4.43 MHz] group delay rec.	$GD_{MR\text{-}4}$	4.43 MHz mode, f_{IN} = 4.43 MHz	340	390	440	ns
M BPF [4.43 MHz] frequency characteristics PB 1	$f_{MP(1)\text{-}4}$	4.43 MHz mode, f_{IN} = 2.6 MHz/4.43 MHz	—	—	–15	dB
M BPF [4.43 MHz] frequency characteristics PB 2	$f_{MP(2)\text{-}4}$	4.43 MHz mode, f_{IN} = 3.93 MHz/4.43 MHz	–5.5	–3.7	–2.0	dB
M BPF [4.43 MHz] frequency characteristics PB 3	$f_{MP(3)\text{-}4}$	4.43 MHz mode, f_{IN} = 4.93 MHz/4.43 MHz	–6.4	–3.9	–1.4	dB
M BPF [4.43 MHz] frequency characteristics PB 4	$f_{MP(4)\text{-}4}$	4.43 MHz mode, f_{IN} = 5.69 MHz/4.43 MHz	—	—	–30	dB
M BPF [4.43 MHz] frequency characteristics PB 5	$f_{MP(5)\text{-}4}$	4.43 MHz mode, f_{IN} = 6.5 MHz/4.43 MHz	—	—	–15	dB
M BPF [4.43 MHz] group delay PB	$DG_{MP\text{-}4}$	4.43 MHz mode, f_{IN} = 4.43 MHz	530	580	630	ns
M BPF [3.58 MHz] frequency characteristics rec. 1	$f_{MR(1)\text{-}4}$	3.58 MHz mode, f_{IN} = 1.5 MHz/3.58 MHz	—	—	–15	dB
M BPF [3.58 MHz] frequency characteristics rec. 2	$f_{MR(2)\text{-}4}$	3.58 MHz mode, f_{IN} = 3.08 MHz/3.58 MHz	–5.5	–3.3	–15	dB
M BPF [3.58 MHz] frequency characteristics rec. 3	$f_{MR(3)\text{-}4}$	3.58 MHz mode, f_{IN} = 4.08 MHz/3.58 MHz	–3.5	–1.0	1.0	dB
M BPF [3.58 MHz] frequency characteristics rec. 4	$f_{MR(4)\text{-}4}$	3.58 MHz mode, f_{IN} = 6.5 MHz/3.58 MHz	—	—	–10	dB
M BPF [3.58 MHz] group delay rec.	$GD_{MR\text{-}4}$	3.58MHz mode, f_{IN} = 3.58 MHz	390	470	550	ns

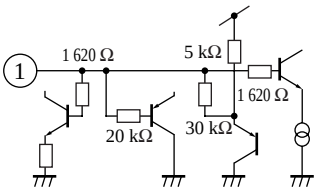
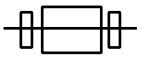
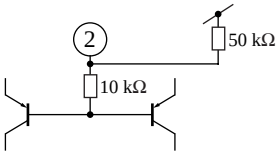
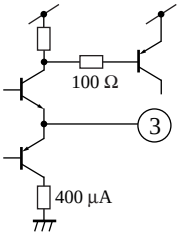
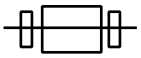
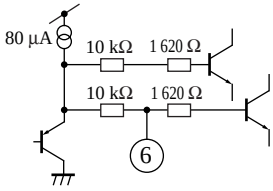
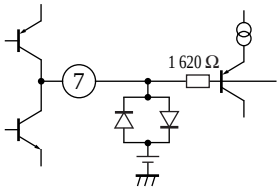
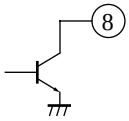
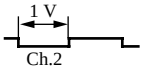
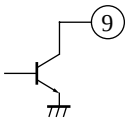
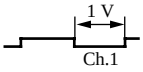
■ Electrical Characteristics at T_a = 25°C (continued)

• Design reference data (continued)

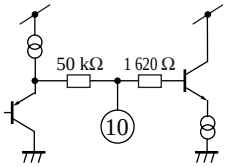
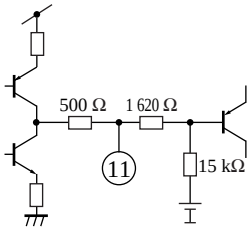
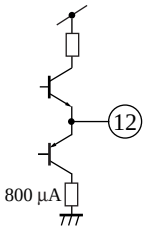
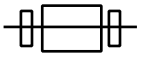
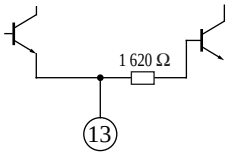
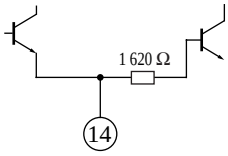
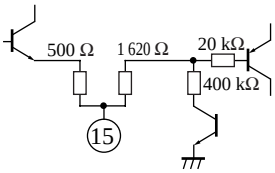
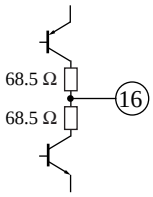
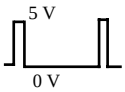
Note) The characteristics listed below are theoretical values based on the IC design and are not guaranteed.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Chroma-system (continued)						
M BPF [3.58 MHz] frequency characteristics PB 1	$f_{MP(1)-4}$	3.58 MHz mode, f_{IN} = 1.5 MHz/3.58 MHz	—	—	–15	dB
M BPF [3.58 MHz] frequency characteristics PB 2	$f_{MP(2)-4}$	3.58 MHz mode, f_{IN} = 3.08 MHz/3.58 MHz	–7.4	–4.8	–2.9	dB
M BPF [3.58 MHz] frequency characteristics PB 3	$f_{MP(3)-4}$	3.58 MHz mode, f_{IN} = 4.08 MHz/3.58 MHz	–7.2	–3.7	–1.2	dB
M BPF [3.58 MHz] frequency characteristics PB 4	$f_{MP(4)-4}$	3.58 MHz mode, f_{IN} = 4.84 MHz/3.58 MHz	—	—	–15	dB
M BPF [3.58 MHz] frequency characteristics PB 5	$f_{MP(5)-4}$	3.58 MHz mode, f_{IN} = 6.5 MHz/3.58 MHz	—	—	–10	dB
M BPF [3.58 MHz] group delay PB	GD_{MP-4}	3.58 MHz mode, f_{IN} = 3.58 MHz	580	660	740	ns
CCD BPF frequency characteristics 1	$f_{CDB(1)}$	4.43 MHz mode, V_{IN} = 300 mV[p-p], f_{IN} = 3.93 MHz/4.43 MHz	–2.3	– 0.3	0.7	dB
CCD BPF frequency characteristics 2	$f_{CDB(2)}$	4.43 MHz mode, V_{IN} = 300 mV[p-p], f_{IN} = 4.93 MHz/4.43 MHz	–2.2	0.1	0.8	dB
CCD BPF frequency characteristics 3	$f_{CDB(3)}$	4.43 MHz mode, V_{IN} = 300 mV[p-p], f_{IN} = 8.86 MHz/4.43 MHz	—	–38	–25	dB
CCD BPF frequency characteristics 4	$f_{CDB(4)}$	4.43 MHz mode, V_{IN} = 300 mV[p-p], f_{IN} = 13.29 MHz/4.43 MHz	—	–40	–30	dB
CCD BPF frequency characteristics 5	$f_{CDB(5)}$	3.58 MHz mode, V_{IN} = 300 mV[p-p], f_{IN} = 3.08 MHz/3.58 MHz	–3.2	– 0.5	0.8	dB
CCD BPF frequency characteristics 6	$f_{CDB(6)}$	3.58 MHz mode, V_{IN} = 300 mV[p-p], f_{IN} = 4.08 MHz/3.58 MHz	–2.8	– 0.2	1.2	dB
CCD BPF frequency characteristics 7	$f_{CDB(7)}$	3.58 MHz mode, V_{IN} = 300 mV[p-p], f_{IN} = 7.16 MHz/3.58 MHz	—	–32	–20	dB
CCD BPF frequency characteristics 8	$f_{CDB(8)}$	3.58 MHz mode, V_{IN} = 300 mV[p-p], f_{IN} = 14.32 MHz/3.58 MHz	—	–48	–30	dB
Phase shifter +45° gain	G_{HPF}	V_{IN} = 300 mV[p-p], f_{IN} = 4.43 MHz	–7.0	–6.0	–5.0	dB
Phase shifter –45° gain	G_{LPF}	V_{IN} = 300 mV[p-p], f_{IN} = 4.43 MHz	–7.0	–6.0	–5.0	dB
Phase shifter +45° phase	P_{HPF}	V_{IN} = 300 mV[p-p], f_{IN} = 4.43 MHz	40	45	50	deg
Phase shifter –45° phase	P_{LPF}	V_{IN} = 300 mV[p-p], f_{IN} = 4.43 MHz	–50	–45	–40	deg
VXO control sensitivity 1	$\beta_{VXO(1)}$	V_{84} = 2.2 V/2.6 V, $(1/2 \times \Delta f_{78})$ /400 mV	1.0	2.2	4.0	Hz/mV
VXO control sensitivity 2	$\beta_{VXO(2)}$	V_{84} = 2.2 V/2.6 V, $(1/2 \times \Delta f_{78})$ /400 mV	0.7	1.7	3.1	Hz/mV

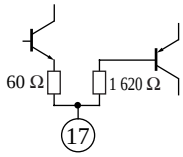
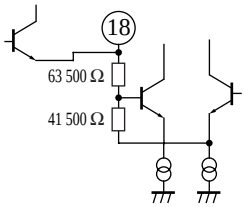
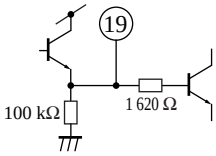
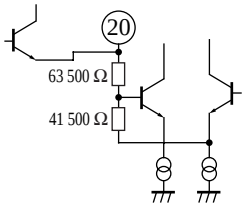
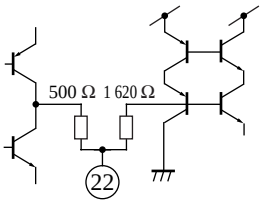
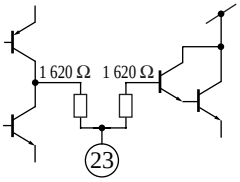
■ Terminal Equivalent Circuits

Pin No.	Equivalent circuit	Impe-dance (Z)	Description	Waveform EE mode	Waveform VV mode	Voltage DC (V)
1		30 kΩ	Y/C mix. PB chroma input pin	—		4.5
2		50 kΩ	EE/VV/trick changeover pin	EE: 3.5 V to 5 V	VV: 1.75 V to 3.0 V Trick: 0 V to 1.25 V	—
3		EF	PB chroma output pin	—		2.0
4	—	—	V_{CC} pin (chroma main)	DC	←	5.0
5	—	—	V_{CC} pin (chroma APC)	DC	←	5.0
6		10 kΩ	BM balance capacitor pin	DC	←	2.7
7		High	ACC detection pin	DC	←	2.15
8		OC	Field AGC detection pin		← Note: off in trick mode	0.2 (on)
9		OC	Field AGC detection pin		← Note: off in trick mode	0.2 (on)

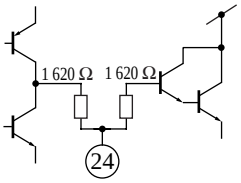
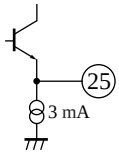
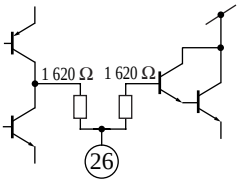
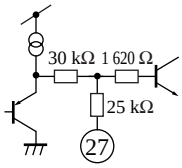
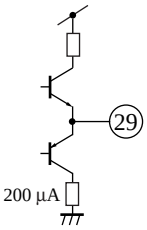
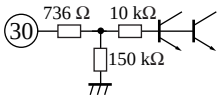
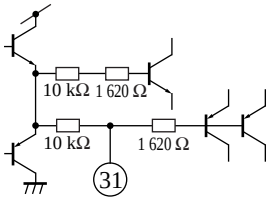
■ Terminal Equivalent Circuits (continued)

Pin No.	Equivalent circuit	Impe-dance (Z)	Description	Waveform EE mode	Waveform VV mode	Voltage DC (V)
10		50 kΩ	Comb-side chroma input pin	—		2.7
11		High	Color killer detection pin	Killer on at 2.13 V or below	←	2.4
12		EF	Comb filter driving output pin	—		2.0
13		EF	SECAM detection 1-pin	DC	←	—
14		EF	SECAM detection 2-pin	DC	←	—
15		500 Ω + VT/IE	Sync. separation det. pin	DC	←	1.4
16		Rc	Sync. separation pulse output pin		←	—

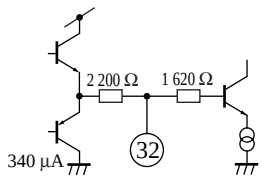
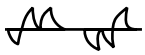
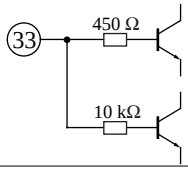
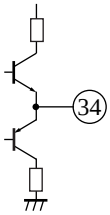
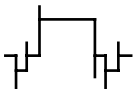
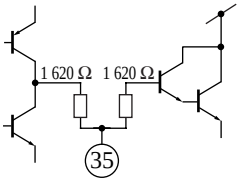
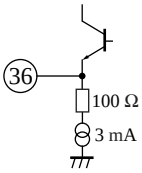
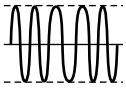
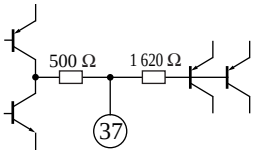
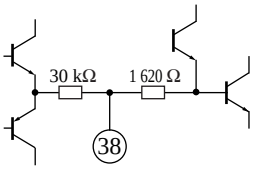
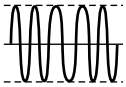
■ Terminal Equivalent Circuits (continued)

Pin No.	Equivalent circuit	Impe-dance (Z)	Description	Waveform EE mode	Waveform VV mode	Voltage DC (V)
17		60 Ω + VT/IE	AGC detection pin	DC	—	2.25
18		105 kΩ	Line input pin		—	3.0
19		EF	V_{REG}	DC	←	2.0
20		105 kΩ	Tuner input pin		—	3.0
21	—	—	V_{CC} pin (Y-system)	DC	←	5.0
22		High	CCD AGC detection pin	DC	←	Typ. 2.4
23		High	Clamp 1 detection pin	DC	←	2.3

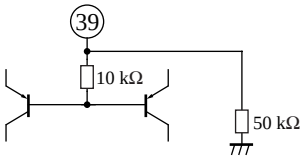
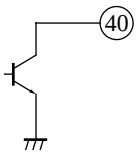
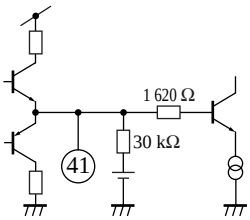
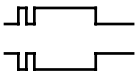
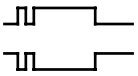
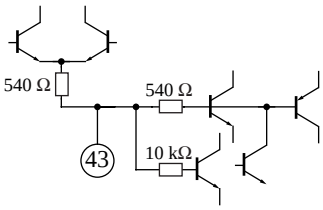
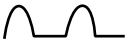
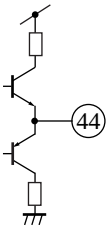
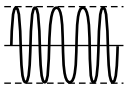
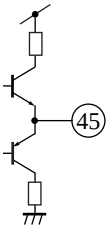
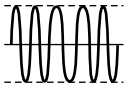
■ Terminal Equivalent Circuits (continued)

Pin No.	Equivalent circuit	Impe-dance (Z)	Description	Waveform EE mode	Waveform VV mode	Voltage DC (V)
24		High	Clamp 2 detection pin	DC		2.3
25		EF	Video signal output pin			Sync. 1.0
26		High	Clamp 4 detection pin	DC		2.3
27		55 kΩ	CCD output pin			2.0
28	—	—	GND (Y-system)	—	—	0
29		EF	CCD input pin			Sync. 1.7
30		150 kΩ	Quasi sync. pulse input pin	—	Single level: 3.5 V to 5 V Gray level: 1.5 V to 3 V Through: 0 V to 1 V	—
31		10 kΩ	Correlation detection DC pin	DC		—

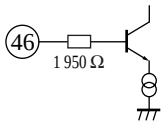
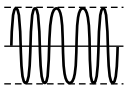
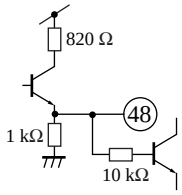
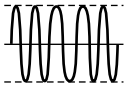
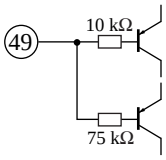
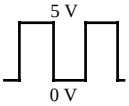
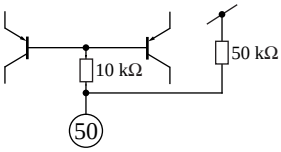
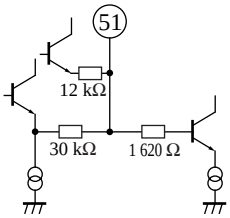
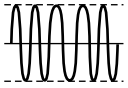
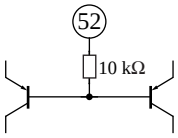
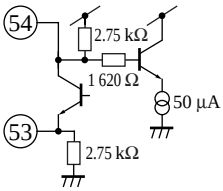
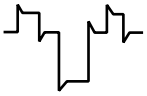
■ Terminal Equivalent Circuits (continued)

Pin No.	Equivalent circuit	Impe-dance (Z)	Description	Waveform		Voltage DC (V)
				EE mode	VV mode	
32		2.2 kΩ	N.C. LPF pin	—		2.4
33		OB	Main emphasis feedback input pin/ VV edit changeover pin		VV edit: 4 V to 5 V	Sync. 1.7
34		EF	Main emphasis output pin		—	Sync. 1.7
35		High	Clamp 3 detection pin	DC	←	2.3
36		EF	MOD output pin		—	2.5
37		High	f_O detection pin	DC	—	2.2
38		30 kΩ	Rec. FM input pin		—	2.7

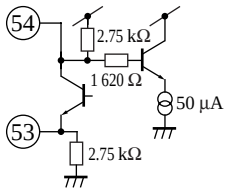
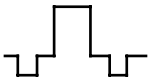
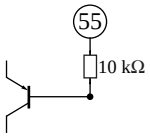
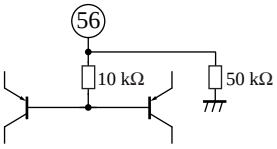
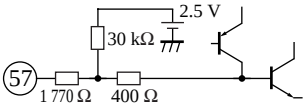
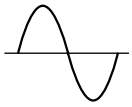
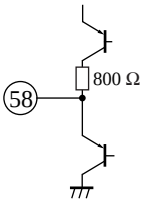
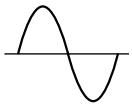
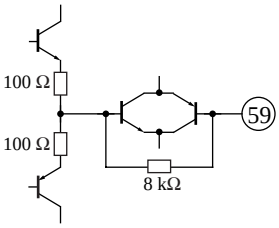
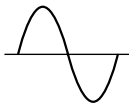
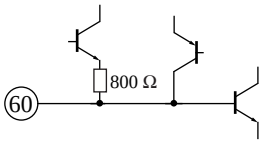
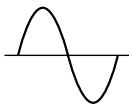
■ Terminal Equivalent Circuits (continued)

Pin No.	Equivalent circuit	Impe-dance (Z)	Description	Waveform		Voltage DC (V)
				EE mode	VV mode	
39		High	Line/test1/tuner changeover pin	Line: 3.5 V to 5 V Test1: 1.75 V to 3 V Tuner: 0 V to 1.25 V	Test1: 1.75 V to 3 V	—
40		Rc	SECAM ID output pin	DC High at SECAM		—
41		EF/ 30 kΩ	Rec. YC output pin/ PB envelope input pin			2.7
42	—	—	GND pin Y (PF-system)	DC	DC	0
43		540 Ω + EF	RF AGC detection pin/ EE edit changeover pin	EE edit: 4 V to 5 V		2.5
44		EF	Phase shift (positive)	DC	2.5 	
45		EF	Phase shift (negative)	DC		2.5

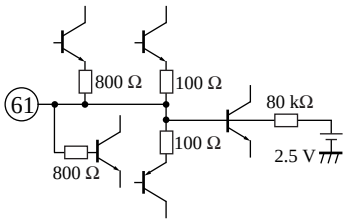
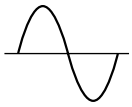
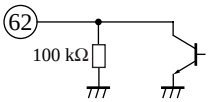
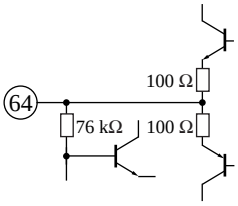
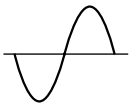
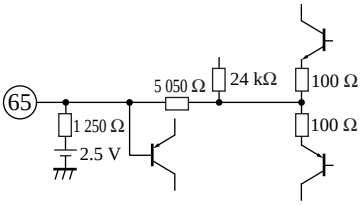
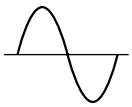
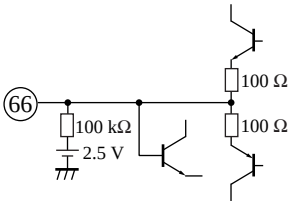
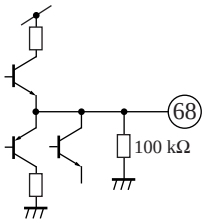
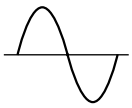
■ Terminal Equivalent Circuits (continued)

Pin No.	Equivalent circuit	Impe-dance (Z)	Description	Waveform EE mode	Waveform VV mode	Voltage DC (V)
46		OB	Phase shift in	DC		2.5
47	—	—	V_{CC} pin Y (MOD output block RF system)	DC	DC	5.0
48		R_E	RF peaking/SQPB changeover pin	DC	 SQPB: 3.25 V to 5 V	1.0
49		OB	Rotary pulse input pin		←	—
50		50 kΩ	MESECAM/PAL/ NTSC changeover pin	MESECAM: 3.5 V to 5 V PAL: 1.75 V to 3 V NTSC: 0 V to 1.25 V	←	—
51		30 kΩ	Y ext. PF FM input pin	—	Pin 51: open  Pin 51: 0 V to 1 V Internal RFEQ	3.0
52		High	PB NTSC changeover pin	PB NTSC: 3.5 V to 5 V Test2: 1.75 V to 3 V Through: 0 V to 1.25 V	←	—
53		VT/ IE	Main de-emphasis peaking pin	—		1.5

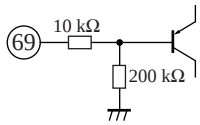
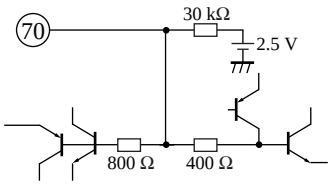
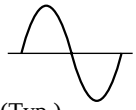
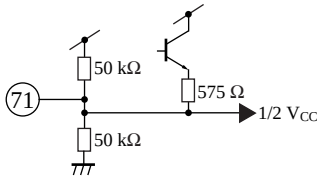
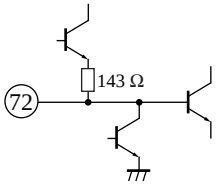
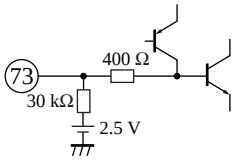
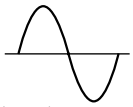
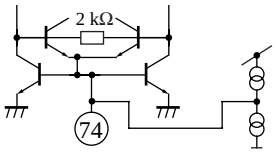
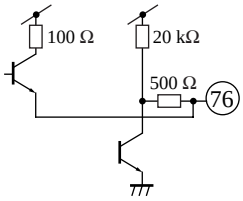
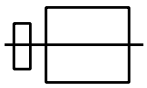
■ Terminal Equivalent Circuits (continued)

Pin No.	Equivalent circuit	Impe-dance (Z)	Description	Waveform EE mode	Waveform VV mode	Voltage DC (V)
54		OC	Main de-emphasis output pin	—		3.5
55		High	4.43 MHz/3.58 MHz changeover pin	4.43: 1.75 V to 5 V 3.58: 0 V to 1.25 V	←	—
56		High	EP/LP/SP changeover pin	EP: 3.5 V to 5 V LP: 1.75 V to 3 V SP: 0 V to 1.25 V	←	—
57		32 kΩ	NA-PB amp. in	—	 –2.95 dB = 94.7 mV[p-p]	2.5
58		EF	NA-PB out	—	 –2.95 dB = 94.7 mV[p-p]	3.2
59		SP SLP 8 kΩ	NA-PB EQ. SW	—		2.5
60		O.B.	NA-PB NF	—		2.5

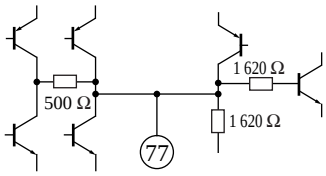
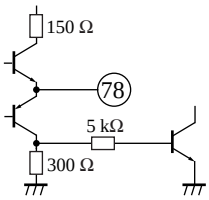
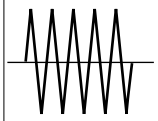
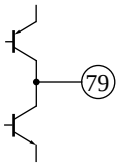
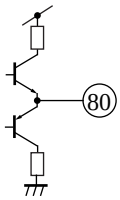
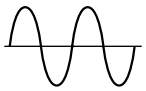
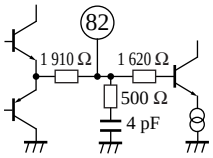
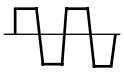
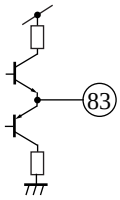
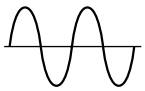
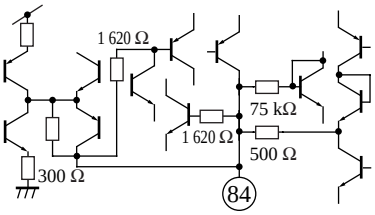
■ Terminal Equivalent Circuits (continued)

Pin No.	Equivalent circuit	Impe-dance (Z)	Description	Waveform EE mode	Waveform VV mode	Voltage DC (V)
61		EE P.P. VV 80 kΩ	NA-PB in	DC	 –68.3 dBV	2.5
62		SP/LP 100 kΩ SLP	NA-PB SLP SW	DC	←	0
63	—	—	GND	—	—	0
64		EE P.P. VV 100 kΩ	NA-rec. out		DC	2.5
65		1 kΩ	NA-rec. EQ. NF		—	2.5
66		SP 100 kΩ LP/ SLP P.P.	NA-rec. EQ. LP/ SLP SW	DC	←	2.5
67	—	—	V_{CC}	DC	←	5.0
68		P.P.	NA-line out	 (Typ.) –5.7 dBV = 1.47 V[p-p]	←	2.5

■ Terminal Equivalent Circuits (continued)

Pin No.	Equivalent circuit	Impe-dance (Z)	Description	Waveform EE mode	Waveform VV mode	Voltage DC (V)
69		210 kΩ	NA-mute in	DC Mute: 3.5 V to 5 V Through: 0 V to 1.25 V	←	—
70		30 kΩ	NA-tuner in	 (Typ.) –29 dBV = 100 mV[p-p]	—	2.5
71		25 kΩ	NA V_{REF}	DC	←	2.5
72		—	NA-AGC det.	DC	←	—
73		30 kΩ	NA-line in	 (Typ.) –29 dBV = 100 mV[p-p]	—	2.5
74		Low	f_{VCO} adjustment pin	DC	DC	0.6
75	—	—	GND (for VCO)	—	—	0
76		20 kΩ	ACC output pin Y LPF output pin Killer output pin	 Low at killer	←	2.7

■ Terminal Equivalent Circuits (continued)

Pin No.	Equivalent circuit	Impe-dance (Z)	Description	Waveform EE mode	Waveform VV mode	Voltage DC (V)
77		Rc	Rec. AFC, PB APC detection pin	DC	DC	2.1
78		EF	$2f_{SC}$ output pin		←	2.7
79		High	Side lock detection pin	Side lock detec-tion current	←	—
80		EF	Xtal output pin 3.58 MHz		←	3.6
81	—	—	GND (chroma-system)	—	—	0
82		1 910 Ω	Xtal input pin		←	2.7
83		EF	Xtal output pin 4.43 MHz		←	3.6
84		EE 75 kΩ VV 75 kΩ	Rec. APC, f_H AFC detection pin	DC	←	2.4

■ Application Circuit Example