SPECIFICATION FOR APPROVAL

Document NO : '07(개A) ER – 044
Date : '07. 05. 21
To (Customer) : LGE AV
From : Radio Frequency Laboratory
Subjection : Proposal for recognition of Tuner

Customer Model NO :
LGIT Model NO : TDVG-H051F

1. Record Of Revision.
2. Specification.
3. Outline Drawing(Attached in Spec.)

Custom Approval Section

Approved	'07. 05. 21 Cheol - Un Jo
Checked	'07. 05. 21 Young - Suk Ro
Designed	'07. 05. 21 Baek - Won Kang

RECORD OF REVISION

CUSTOMER: LGE AV

NO	Date	Subject	Contents	Letter	Sign
1	’07. 05. 21	Approval Sheet	New	07(개A)ER-044	

Approved	Checked	Designed	MODEL NO	TDVG-H051F
’07.05.21 Cheol - Un Jo	’07.05.21 Young - Suk Ro	’07.05.21 Baek - Won Kang	TITLE	Record of Revision
			DOCUMENT NO	HR 40337

S P E C I F I C A T I O N

LG INNOTEK Co., Ltd.

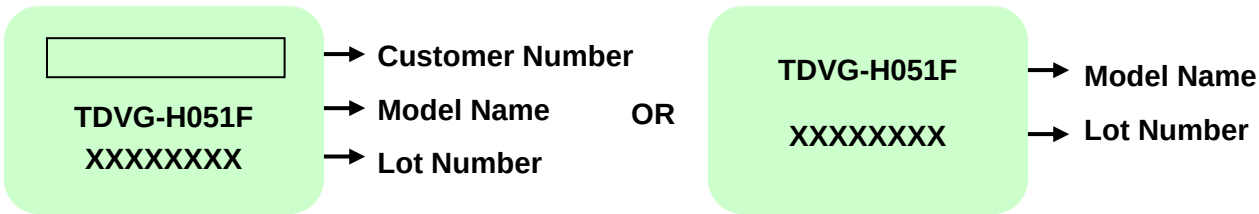
Approved	Checked	Designed	Model NO.	TDVG-H051F
07. 05. 18 Cheol-Un Jo	07. 05. 18 Young-Suk Ro	07. 05. 18 Baek-Won Kang	Document NO.	HC40372

Index

1. Features

ATSC Half NIM (D2A Tuner)
Built in 30V DC-DC Converter
IIC bus interface
Horizontal Type
Built in RF Modulator(3/4 CH. Output)
Balanced Digital IF Output

2. Label Marking



3. General Specification

3-1. Supporting system : ATSC

3-2. Receiving channel

VHF/Low : 2 ~ B Ch. (57 ~ 129MHz)
VHF/High : C ~ W+11 Ch. (135 ~ 363MHz)
UHF : W+12 ~ 69 Ch. (369 ~ 803MHz)

3-3. Intermediate frequency

Center intermediate frequency : 44MHz

3-4. Input/ Output condition

ANT Input impedance : 75Ω unbalance
ANT Output impedance: 75Ω unbalance
Video Input impedance : 0.7kΩ ~1.3kΩ(Typ.1kΩ)
Video Output impedance : 10kΩ Min.
Control impedance : 1kΩ Min.(Typ.10kΩ)
IF Output impedance : 75Ω balance

3-5. Output channel of modulator

	Terminal NO. 2
US 3 CH.	+5V
US 4 CH.	0V

3-6. Channel Bandwidth : 6MHz

4. Operating Test Conditions

4-1. Voltage : + 5V (± 0.25V)

4-2. Operating temperature : 0 ℃ ~ +60 ℃

4-3. Operating humidity : Less than 85%RH (at 40℃)

5. Storage Test Conditions

5-1. Storage temperature : -20℃ ~ +70℃

5-2. Storage humidity : Less than 95%RH (at 40℃)

6. Absolute Maximum Voltage

Terminal	Max. Voltage
+B1	+5.5V/DC
+B2	+5.5V/DC

7. Standard Test Conditions

The Test for electrical specification shall be performed under the following conditions
Otherwise this following conditions, not guaranteed this performance.

7-1. Ambient condition

Temperature	25 ± 5℃
Humidity	65 ± 15%

7-2. Power supply voltages

Terminal	Supply Voltage
+B1	+5.0V ± 0.25V
+B2	+5.0V ± 0.25V
CONTROL	+5.0V ± 0.25V

8. Electrical characteristics.

8-1. RF Modulator section characteristics

Item	Specification				Conditions
	Min.	Typ.	Max.	Unit	
Video modulation	74	80	86	%	Input signal : 1.0Vp-p white Measure at the output of the standard demodulator
Video limit modulation	87	93	99	%	Input signal : 1.5Vp-p stair-steps or ramp. Measure at the output of the standard demodulator.
V/S ratio	10:3.8	10:4.0	10:4.1	-	Input signal :1.0Vp-p white V : S = 10 : 4 Measure at the output of the standard demodulator.
Video amplitude frequency characteristics	-3.0	-0.5	+3.0	dB	Measure range : 0.1㎒ ~ 4.2㎒ Based on 1㎒
Differential Gain (DG)	-	2	7	%	Input signal : FCC Composite Chrominance : 20 IRE Luminance : 0 ~ 90 %
Differential Phase (DP)	-	2	7	%	Input signal : FCC Composite Chrominance : 20 IRE Luminance : 0 ~ 90 %
Video S/N	45	47	-	dB	1)
Chroma beat (920㎑ P.C.S. beat)	55	65	-	dB	2)
Audio modulation (deviation)	32 (64)	40 (80)	48 (96)	㎑ dev (%)	Input signal : 1.23Vp-p 1㎑ sine wave (100 % modulation = ± 25㎑ dev.)
Audio maximum modulation	150 (300)	220 (440)	-	㎑ dev (%)	Input signal : 1㎑ sine wave The input should be adjusted to the level just before the saturation of the modulation.

Note 1) Measure at the out of the Standard demodulator(5126A - NIHON TSUSHINKI)
and Video Measurement (VM700A - TEKTRONIX)
HPF : 100㎑, LPF : 4.2㎒, SC TRAP : ON, WEIGHT : ON
Input signals : Video : 100% white signal , Audio : none, Video band : 0.1㎒ ~ 4.2㎒

Note 2) Input signal : 0.4Vp-p 3.58㎒ sine wave, Use spectrum analyzer to measure the level of Fp + 0.92㎒
The value is relative to the level of Fp without video modulation.

Item	Specification				Conditions
	Min.	Typ.	Max.	Unit	
Audio amplitude frequency characteristics	-3.0	+0.2 -0.6	+3.0	dB	Input signal : 1.23Vp-p Measure range : 100㎐ ~ 10㎑ Based on 1㎑
Audio distortion	-	0.5	2.0	%	Input signals : Audio : 1.23Vp-p, 1㎑ sine wave Video : 1Vp-p color bar De-emphasis is on.(75 μ sec)
Audio S/N	45	48	-	dB	Input signals : Audio : 1.23Vp-p, 1㎑ sine wave Video : All black (sync. only) Use standard demodulator of inter-carrier system. De-emphasis is on. (75 μ sec)
Audio buzz	45	48	-	dB	Video input signal : 1Vp-p color bar Other conditions : same as item Audio S/N.
Video carrier output level	63	66	69	dBμV	Video input signal : 1Vp-p 100% white signal.
P/S ratio (sound carrier level)	-13	-16.0	19.0	dB	Audio input signal : none Other conditions : same as item Video carrier output level.
Video carrier frequency	-150	-	+150	kHz	Video input signal : none
Sound carrier frequency	4493	4500	4507	kHz	Audio input signal : none The measurements are taken after 1 min. from the power on.
Out-band spurious	-	-	39.5	dBμV	Video input signal : 1Vp-p color bar Measure range : 0 ~ 1㎓ Except the range from Fp-4.6㎒ to Fp+7.4㎒.
In-band spurious	60	-	-	dB	Input signals : Video : none Audio : none Measure range : Fp~Fp+4.5㎒.
Terminal leakage	-	-	54	dBμV	Measure range : 0 ~ 1㎓ except GND.

8-1-1. Stability

8-1-1-1. Video carrier frequency rise up time.
The time to approach the set value ±50㎑ : within 3 seconds

8-1-1-2. Audio carrier frequency rise up time.
The time to approach the set value ±5㎑ : within 10 seconds

8-1-1-3. Video carrier frequency shift by supply voltage drift.
Within ±10㎑ by ±0.3V shift of the supply voltage.

8-1-1-4. Audio carrier frequency shift by supply voltage drift.
Within ±2㎑ by ±0.3V shift of the supply voltage.

8-1-2. Thermal Stability

8-1-2-1. Thermal stability of video modulation.
Within ±8% based on the temperature of 25℃.

※ Unless otherwise specified, thermal stability tests shell be performed under the following conditions.

Measurement temperature range : -10℃ ~ 60℃

Humidity range : 45%RH ~85%RH

Test measurement order and time :
25℃ → -10℃(2H) → 10℃(1H) → 25℃(1H) → 45℃(1H) → 60℃(2H)

8-1-2-2. Thermal stability of video carrier frequency.
Within ±150㎑ based on the temperature of 25℃.

8-1-2-3. Thermal stability of video carrier output level.
Within ±4dB based on the temperature of 25℃.

8-1-2-4. Thermal stability of audio modulation.
Within ±16% on the temperature of 25℃.

8-1-2-5. Thermal stability of audio carrier frequency.
Within ±20kHz on the temperature of 25℃.

8-1-2-6. Thermal stability of P/S ratio
Within ±3.0 dB based on the temperature of 25℃, but the P/S ratio itself should not be less than 13 dB.

8-2. Antenna section characteristics

Item	Specification				Conditions
	Min.	Typ.	Max.	Unit	
VSWR Ⅰ	-	-	5		ANT in terminal
VSWR Ⅱ	-	2	3		ANT out terminal
Antenna Leakage	-	-	46	dBuV	54 to < 1000MHz
	-	-	52	dBuV	1000 to < 1800MHz

8-3. Tuner section characteristics

When the test characteristics, test point is IF output terminal.

Item		Specification				Conditions
		Min.	Typ.	Max.	Unit	
Frequency Range	VHF-Low	57	-	129	MHz	
	VHF-High	135	-	363		
	UHF	369	-	803		
Frequency Margin	VHF-Low	1	-	-	MHz	
	VHF-High	2	-	-		
	UHF	2	-	-		
Image Rejection	VHF-Low	60	70	-	dB	
	VHF-High	55	65	-		
	UHF	50	60	-		
Noise Figure		-	6	10	dB	
Power Gain	All CH.	-	70	-	dB	IF output terminal
RF AGC Range		35	50	-	dB	Internal operation
IF AGC Range		45	60	-	dB	
1% Cross Modulation	N±2	62	-	-	dBuV	Undesired: AM 80% Modulation, S/I=46dB
IF Rejection			50	-	dB	
ESD[1)]		-	-	± 8	kV	Direct contact discharge
Phase Noise		-	-85	-	dBc/Hz	@10kHz

Note 1) Test is performed with a voltage discharge from a 150PF capacitor over a 330 Ω series resistance in the discharge path.
There is a direct contact between the test probe head and the unit under test.

9. PLL description

A detailed description of the I²C-bus specification with applications is given in datasheet of the SN761668

9-1. Write mode

	MSB							LSB	
Address Byte (ADB)	1	1	0	0	0	MA1	MA0	R/$\overline{W}$=0	A
Divider Byte 1 (DB1)	0	N14	N13	N12	N11	N10	N9	N8	A
Divider Byte 2 (DB2)	N7	N6	N5	N4	N3	N2	N1	N0	A
Control Byte 1 (CB1)	1	0	ATP2	ATP1	ATP0	RS2	RS1	RS0	A
Band switch Byte (BB)	CP1	CP0	AISL	P5	BS4	BS3	BS2	BS1	A
Control Byte 2 (CB2)	1	1	ATC	STBY	T3	T2	T1/ATSS	T0/XLO	A

MA1, MA0 : Address-set bits (see Table 9-1-1)

ATP : RF AGC start-point control bits (see Table 9-1-3)

RS : Reference divider ratio-selection bits (see Table 9-1-4)

CP : Charge-pump current-set bit (see Table 9-1-5)

AISL : RF AGC detector input selection bit, AISL=0 : IF amplifier(default), AISL=1 : Mixer output

P5 : Port output/ADC input control bit, P5=0 : ADC INPUT, P5=1 : Tr=ON(default)

BS : Band-switch control bits (see Table 9-1-6), BSn=0 : Tr=OFF, BSn=1 : Tr=ON

ATC : RF AGC current-set bit, ATC=0 : Current=300nA, ATC=1 : Current=15uA(default)

STBY : Power standby mode-control bit, STBY=0 : Normal operation(default), STBY=1 : Standby mode/stop MOP function (XTALOUT is available even in standby mode)

T3, T2, T1/ATSS, T0/XLO : TEST bits, RF AGC shift bit, XTAL OUT control bit (see Table 9-1-7)

9-1-1. Address selection

$Vcc(B_{TU})$ = +5 V (Tuner section supply voltage)

MA1	MA0	Voltage applied on AS input
0	**0**	0 $Vcc(B_{TU})$ to 0.1 $Vcc(B_{TU})$
0	1	Open or 0.2 $Vcc(B_{TU})$ to 0.3 $Vcc(B_{TU})$
1	0	0.4 $Vcc(B_{TU})$ to 0.6 $Vcc(B_{TU})$
1	1	0.9 $Vcc(B_{TU})$ to $Vcc(B_{TU})$

9-1-2. Programmable Divider setting (Bytes DB1 and DB2)

Divider ratio : N = Fosc/Fss

[Where Fosc = (F_{RF} + F_{IF}) and Fss = step-size set by RS2 and RS1 and RS0 as described blew]

N=16384*N14 + 8192*N13 + 4096*N12 + 2048*N11 + 1024*N10 + 512*N9 + 256*N8 + 128*N7 + 64*N6 + 32*N5 + 16*N4 + 8*N3 + 4*N2 + 2*N1 + N0

[Note : F_{IF} = 44 MHz for Digital Reception Control bytes.]

9-1-3. RF AGC Start Point

T1/ATSS	ATP2	ATP1	ATP0	IF OUT LEVEL(dBuV)
0	0	0	0	117
0	0	0	1	114
0	0	1	0	111
0	0	1	1	108
0	1	0	0	105
0	1	0	1	102
0	1	1	0	99
0	1	1	1	Disabled
1	0	0	0	112
1	**0**	**0**	**1**	**109**
1	0	1	0	106
1	0	1	1	103
1	1	0	0	100
1	1	0	1	97
1	1	1	0	94
1	1	1	1	Disabled

9-1-4. Ratio Select Bit

RS2	RS1	RS0	Fref	Reference divider ratio
0	0	0	166.67KHz	24
0	0	1	142.86KHz	28
0	1	0	80KHz	50
0	**1**	**1**	**62.5KHz**	**64**
1	0	0	31.25KHz	128
1	X	1	50KHz	80

9-1-5. Charge pump settings

CP1	CP0	Charge pump current
0	0	70uA
0	**1**	**140uA**
1	0	350uA
1	1	600uA

9-1-6. Band selection byte

Band	Band switch byte			
	BS4	BS3	BS2	BS1
VHF-LOW	0	X	0	1
VHF-HIGH	0	X	1	0
UHF	1	X	0	0

9-1-7. Test Bits/XTAL OUT Control

T3	T2	T1/ATSS	T0/XLO	Device operation	XTAL OUT 4MHz output
0	0	X	0	Normal operation	Enabled
0	**0**	**X**	**1**	**Normal operation**	**Disabled**
X	1	X	X	Test mode	Not available
1	X	X	X	Test mode	Not available

9-2. Read mode

	MSB							LSB	
Address byte(ADB)	1	1	0	0	0	MA1	MA0	R/$\overline{W}$=1	A
Status byte(SB)	POR	FL	1	1	X	A2	A1	A0	-

MA1, MA0 : Address-set bits (see Table 9-1-1)
POR : Power on reset flag (POR set : power on, POR reset : end-of-data transmission procedure)
FL : In-lock flag (FL =1: PLL locked, F=0 : PLL unlocked)

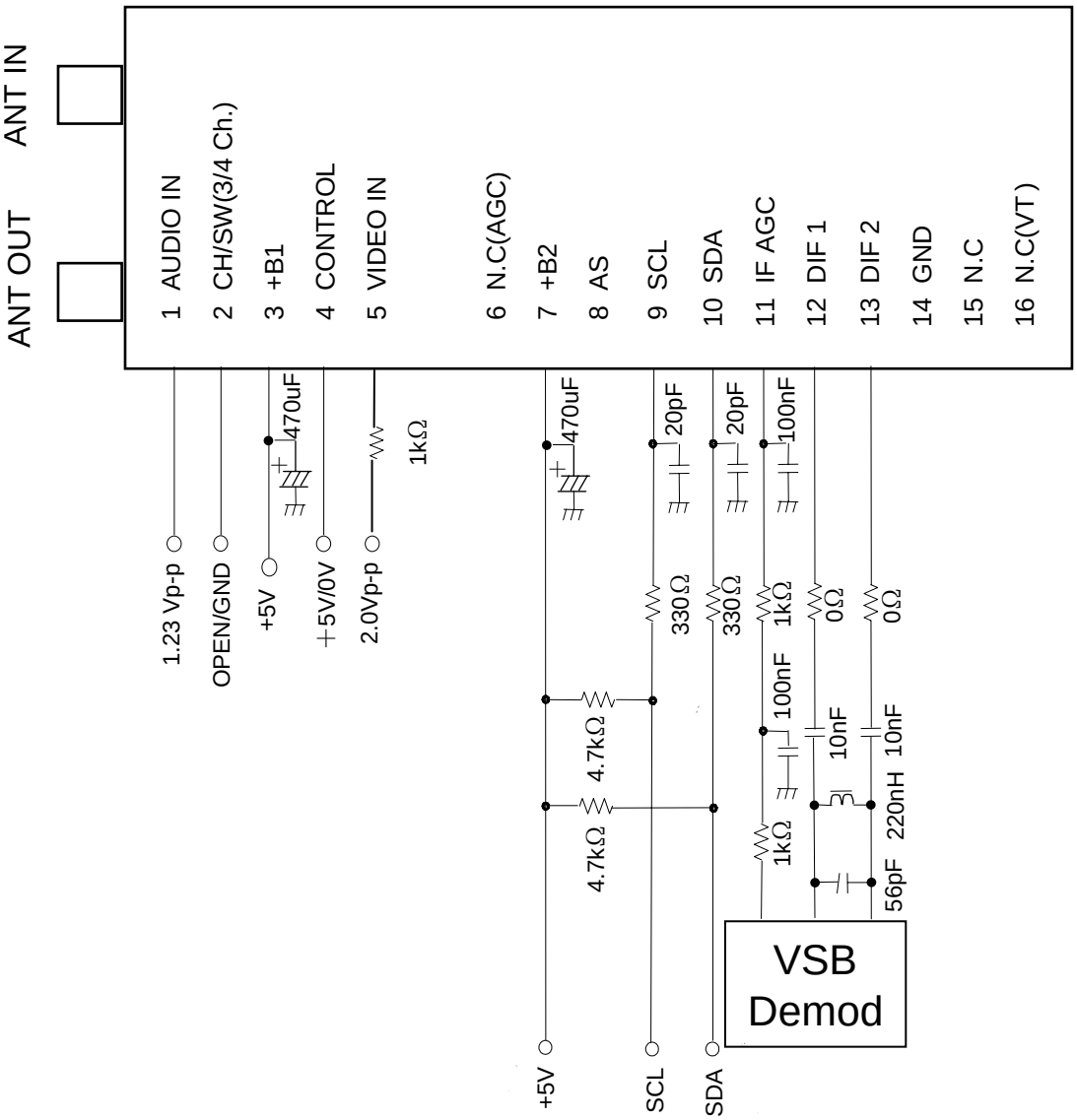
10. Environmental tests

Item	Test Conditions	Tuner
Heat Load Test	Initial value measure at standard test condition. Leave samples in 70℃ ±2℃ for 96±5 hours, and in standard test condition for 30 minutes, then take measurements within 1 hour. -Supply voltage : standard ± 5% -Supply voltage cycle : 1.5h on, o.5h off	Compared with initial value - Tuning Voltage : ±2.0V Max. - Power Gain : ±6 dB Max.
Humidity Load Test	Leave samples in 40±2℃ for 24±2 hours, and in standard test condition for 30 minutes, Then take measurements. Leave samples in 40±5℃ for 90～95%RH, for 96±5 hours, and in standard test condition for 30 minutes, then take measurements within 1 hour. -Supply voltage : standard + 5% -Supply voltage cycle : 1.5h on, 0.5h off	
Cold Test	Initial value measure at standard test condition. Leave samples in -20℃ ± 2℃ for 96±5 hours, and in standard test condition for 2 hours then take measurements within 1 hour.	
Operating Life Test	Take measurements in standard test condition. Leave samples for 1000 hours, then take measurements within 1 hour. - Supply voltage : standard.	
Impact Test	Impact acceleration : 50m/sec^2 Impact time : 11msec Impact time and direction : 3 times each in 6 direction	

▪ Storage Environment of Tuner

"Do not use or store TUNER in a corrosive atmosphere, especially where chloride gas, sulfide gas, acid, alkali, salt or the like are present. And avoid exposure to moisture. Store the TUNER where the temperature and relative humidity do not exceed 5 to 40°C and 20 to 70%. Use TUNER within 6 months. Check the solder ability in case of 6 months or more."

11. Application & Test Circuits



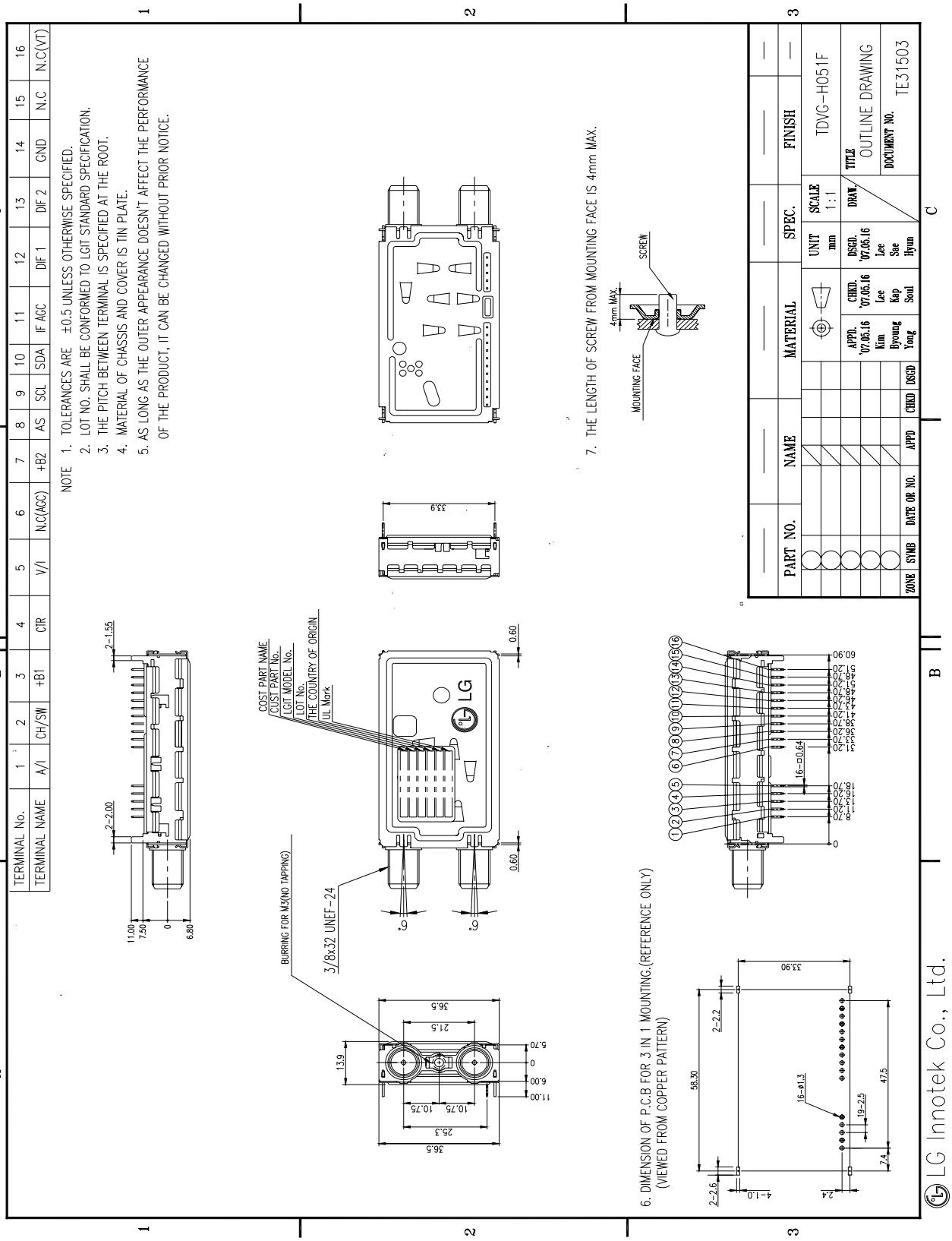
12. Pin Descriptions

Pin No	Pin Name	Pin Description
1	A/I	Audio Input
2	CH/SW	Channel Switch (3/4 Ch.)
3	+B1	+5V Supply voltage for MD part
4	CTR	Control
5	V/I	Video Input
6	N.C(AGC)	RF AGC voltage test point (Test only)
7	+B2	+5V Supply voltage for Tuner module
8	AS	Tuner Address Selectable port
9	SCL	I^2C CLOCK for PLL
10	SDA	I^2C DATA for PLL
11	IF AGC	IF Gain Controlled Amplifier Control
12	DIF 1	Digital IF (44MHz) Out1
13	DIF 2	Digital IF (44MHz) Out2
14	GND	Ground
15	N.C	Not Connected
16	N.C(VT)	Tuning voltage test point (Test Only)

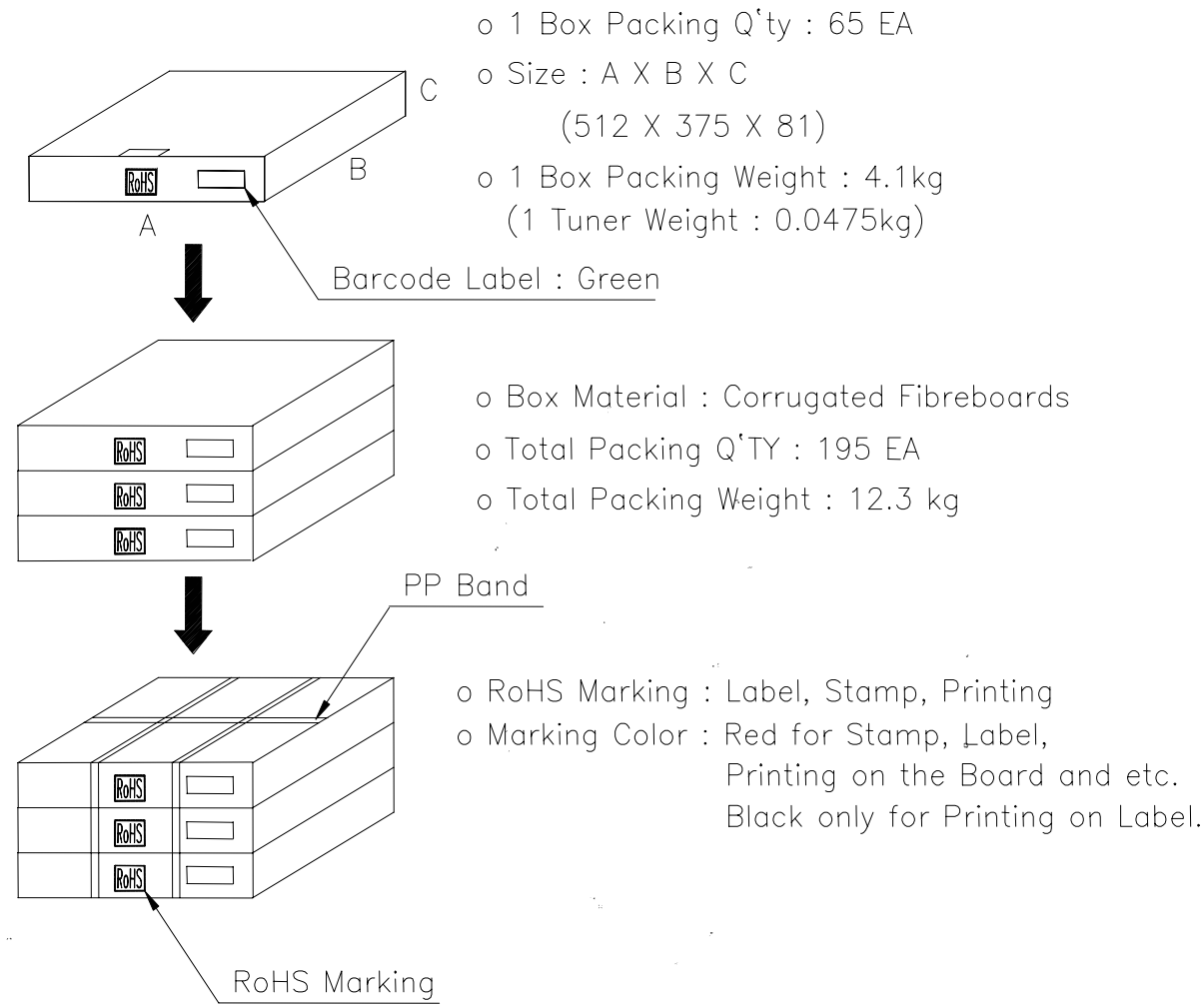
13. Parts List

Parts Name	Specification	QTY	Maker
MOPLL IC	SN761668	1	Texas Instruments
MD IC	TA1372FNG	1	Toshiba
RF FET	BF1202WR	2	Philips
TR	BC847BT	1	Infineon
Switching Diode	BA892	5	Infineon
Varactor Diode	BB659	12	Infineon
X-tal	4MHz	1	Jungwon
SAW Filter	X6764X	1	Epcos
Capacitor	Capacitor	104	SS, TDK, Murata
Resistor	Resistor	97	SS, Rohm
Air Coil	Air Coil	22	LGIT
Chip Inductor	Chip Inductor	9	TDK
Bead	Bead	1	Samwha
Axial Inductor	Axial Inductor	1	ABCO
CAP	CAP	1	Samwha
PCB	-	1	PCBLIVE
Top/Bottom Cover	-	2	OHSUNG
Chassis	-	1	OHSUNG
Terminal	-	1	YEON-HO
F-Connector	-	1	NINGBO

14. Mechanical Diagram



15. Packaging



16. Revision History

Data of changes	Index	Modification	Page