

TO : _____

Digital Terrestrial NIM with RF loopthrough

Revision : 1.0

Custom name :

**Samsung name : TDTC9251DH01C
(B/W: 7,8MHz)**

Approved by :

Date : Apr. 22. 2003

WRITTEN	CHECKED	APPROVED

ADD : TUNER LAB., Digital Group, Display & Digital Device Div.,
SAMSUNG ELECTRO-MECHANICS CO., LTD,
314, maetan-dong, paldal-ku, suwon-city, kyungki-do, KOREA

TEL : 82-31-210-6615 FAX : 82-31-210-6380



SAMSUNG ELECTRO-MECHANICS CO., LTD

1. Description

- This Terrestrial NIM(Network Interface Module) is designed for using in DVB-T system.
- It builds in COFDM-Demod IC.
- It's used to a single conversion approach with the reception frequency range
in VHF C5 ~ C12 (174MHz ~ 230MHz),
UHF C21 ~ C69 (470MHz ~ 862MHz)
- Band selection and tuning is done by PLL IC.
PLL IC is controlled by the COFDM-Demod IC.(external control port pins)

2. Mechanical Characteristics

2-1 Dimensions : refer outline drawing

PIN	CONNECTION	REMARK
1	N.C	
2	N.C	
3	N.C	
4	RF AGC(N.C)	Test Point.
5	5V	analog(RF Block).
6	30V	Tuning Voltage
7	N.C	Connected with pin 5
8	N.C	
9	1'st IF (N.C)	Test Point
10	2'nd IF (N.C)	Test Point
11	digital 5V	For Demod IC
12	analog 5V	For Demod IC
13	N.C	
14	analog 3.3V	For Demod IC
15	digital 3.3V	For Demod IC
16	reset	reset the module.
17	error out	uncorrectable block indicator.
18	frame sync	MPEG out start signal.
19	Valid	MPEG output data valid.
20	MDCLOCK	MPEG output clock
21 ~ 28	MDO[7:0]	MPEG data output.
29	SDA	I2C Data
30	SCL	I2C Clock

2-2 RF Input connector : IEC type, female

2-3 RF output connector : IEC type, male

2-4 Tuner IIC connection : pins (ref Fig.1)

3. General Characteristics

3-1 Temperature Range :

Operating temperature	:	0 ~ +65°C
Storage temperature	:	-40 ~ +70°C

3-2 Test conditions : All data hold under following conditions

T(amb.)	:	+25± 2°C
Humidity	:	45 ~65 % RH
Supply voltage	:	+5V± 2%
RF AGC voltage	:	+4V± 2%
IF AGC voltage	:	+4V± 2%
Tuning voltage	:	+30V± 2%

3-3 Current Consumption

+30V(tuning voltage : pin6)	:	1mA typ 2mA max.
+5V(RF BLOCK)	:	140mA max.
+5V(IF AMP. with AGC)	:	60mA max.
+3.3V(Demod IC)	:	150mA max.

4. Electrical Characteristics

4-1 Input Frequency Range	:	174MHz ~ 230MHz 470MHz ~ 862MHz
4-2 Input Signal Level	:	-78dBm ~ -20dBm (Average power)
4-3 Voltage Gain(1st IF)	:	38dB typ. 35dBmin.
4-4 Noise Figure	:	7dB typ. 10dB max. (at max. gain)
4-5 OFDM-Demod IC	:	MT352 (produced by Zarlink)
4-6 Input Impedance	:	75Ω
4-7 Return Loss ANT in		
ANT in (174MHz ~ 862MHz)	:	5dB min.
Loop-through out (50 ~ 862 MHz)	:	5dB min.
4-8 IF frequency	:	36.167MHz
4-9 IF band width	:	7,8MHz(-3dB) typ.
4-10 Spurious Signals at Input Terminal		
Local Oscillator Leakage	:	46dBuV max.
4-11 Reference PLL X-tal Frequency	:	4MHz
4-12 Phase Noise		
@ 1kHz	:	-75dBc/Hz typ. -70dBc/Hz max.
@ 10kHz	:	-85dBc/Hz typ. -75dBc/Hz max.
4-13 Control Data Bus	:	I ² C
4-14 Control Data Format	:	refer the following I ² C BUS
4-15 RF output ripple	:	4dBpp
4-16 RF output Gain	:	1 ± 2dB

4-17 Image PAL Interference Protection Ratio

: -49dB typ. -46dB min (at 2K,8K mode) NOTE1

4-18-1 Adjacent PAL Interference Protection Ratio. (N-1), (N+1)

: -38dB typ. -35dB min (at 2K,8K mode) NOTE1. ※VHF(7MHz) : T.B.F

4-18-2 Adjacent DVB-T Interference Protection Ratio. (N-1), (N+1)

: -34dB typ. -30dB min (at 2K,8Kmode) NOTE1. ※VHF(7MHz) : T.B.F

4-19 Co-Channel PAL Interference Ratio. (Co-channel filter ON)

: +1dB typ. +4dB min. NOTE1.

※ NOTE1 :

Desire input signal condition :

a: Modulation : 64QAM b: Guard Interval : 1/32

c: Puncture Rate : 2/3

Undesired(analog) input signal condition :

PAL : Video 75% color bars FM sound : 1kHz tone(P/S : 13dB)

(± 50kHz deviation, freq. P/S : 6.0MHz)

※ Adjacent channel PAL interference test procedure

a: Use changeover switch to select power meter

b: Turn DVB-T source off ; adjust PAL PSP level to -25dBm

c: Turn PAL off ; turn DVB-T on

d: Adjust DVB-T to -25dBm

e: Turn PAL on and increase step attenuator in DVB-T channel until Q.E.F.

※ Adjacent channel DVB-T interference test procedure

a: Use changeover switch to select power meter

b: Turn desired DVB-T source off ; adjust undesired DVB-T level to -35dBm

c: Turn undesired DVB-T source off ; turn desired DVB-T on.

d: Adjust desired DVB-T to -35dBm

e: Turn undesired DVB-T on and increase step attenuator in desired DVB-T channel until Q.E.F.

※ Co-Channel PAL interference test procedure

a: Use changeover switch to select power meter

b: Turn PAL source off ; adjust DVB-T level to -50dBm

c: Turn DVB-T off ; turn PAL on

d: Adjust PAL to -50dBm

e: Turn DVB-T on and increase step attenuator in PAL channel until Q.E.F.

4-20 Active White Gaussian Noise Condition. at QEF.

: 17.4dB typ. 18.4dB max. (64QAM, 2K,8K Mode, Code rate:2/3, input level:-50dBm)

: 22.5dB typ. 23.5dB max. (64QAM, 2K,8K Mode, Code rate:7/8, input level:-50dBm)

4-21 Sensitivity Condition. at QEF

:-80dBm typ. -77dBm max.(64QAM, 2K,8K Mode, Code rate:2/3,Guard Interval 1/32)

:-73dBm typ. -70dBm max.(64QAM, 2K,8K Mode, Code rate:7/8,Guard Interval 1/32)

4-22 Multipath channel Interference (64QAM, 2K, 2/3code rate, 1/32G.I)

short echo : 20.2dB max

long echo : 22.2dB max

Path	Delay(us)	Relative Attenuation(dB)	Path	Delay(us)	Relative Attenuation(dB)
1	0	2.8	1	0	0
2	0.05	0	2	5	9
3	0.4	3.8	3	14	22
4	1.45	0.1	4	35	25
5	2.3	2.6	5	54	27
6	2.8	1.3	6	75	28

short delay parameter

long delay parameter

5. TUNER PLL PROGRAMMING

5-1. Bit allocation Write/Read

Byte	MSB (a)	bit6	bit5	bit4	bit3	bit2	bit1	LSB	Ack	REMARK
Write Data										
Address Byte	1	1	0	0	0	MA1	MA0	0	A	
Divider Byte1	0	2 ¹⁴	2 ¹³	2 ¹²	2 ¹¹	2 ¹⁰	2 ⁹	2 ⁸	A	
Divider Byte2	2 ⁷	2 ⁶	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰	A	
Control Byte	1	CP	T2	T1	T0	RSA	RSB	OS	A	
Bandswitch Byte	0	0	0	0	P3	P2	P1	P0	A	
Read Data										
Address Byte	1	1	0	0	0	MA1	MA0	1	A	
Status Byte	POR	FL	1	1	AGC	A2	A1	A0	A	

(a) MSB shifted first.

5-2. Description of symbols

MA1 and MA0 : Programmable address bits (**refer 5-3**)

$2^{14} - 2^0$: Programmable division ratio control bits

N: programmed division ratio

$F_o = N * (F_x / N_{ref})$ F_o : local osc frequency,

$N = F_o * (N_{ref} / F_x)$ F_x : x-tal osc frequency

N_{ref} : reference osc divided ratio

CP : Charge-pump current selection(**refer 5-5**)

T0,T1,T2 : Test bits

Extended mode, charge pump current 50 and 250uA selectable

: T2,T1,T0 = 1,1,0

Extended mode, charge pump current 125 and 650uA selectable

: T2,T1,T0 = 1,1,1

RSA,RSB : Reference division ratio selection(**refer 5-4**)

OS : Tuning amplifier control bit

bit=0 : enable V_t

bit=1 : disable V_t

P3,P2,P1,P0 : Band selection port (**refer 5-6**)

POR : Phase lock flag

A2,A1,A0 : ADC data

X : don't care

5-3. Address selection

AS input voltage level	MA1	MA0
$(0 \sim 0.1) * V_{VCC}$	0	0
Open Circuit	0	1
$(0.4 \sim 0.6) * V_{VCC}$	1	0
$(0.9 \sim 1) * V_{VCC}$	1	1

5-4. Reference divider ratios (4MHz X-TAL external reference)

Ratio	f _{ref}	Mode	T2	T1	RSA	RSB
24	166.7kHz	x	x	x	1	0
64	62.5kHz	x	x	x	1	1
32	125kHz	extended	1	1	0	0
28	142.9kHz	extended	1	1	0	1

T0,T1,T2 : Test bits

Extended mode, charge pump current 50 and 250uA selectable

: T2,T1,T0 = 1,1,0

Extended mode, charge pump current 125 and 650uA selectable

: T2,T1,T0 = 1,1,1

RSA,RSB : Reference division ratio selection(**refer 5-4**)

OS : Tuning amplifier control bit

bit=0 : enable Vt

bit=1 : disable Vt

P3,P2,P1,P0 : Band selection port (**refer 5-6**)

POR : Phase lock flag

A2,A1,A0 : ADC data

X : don't care

5-5. Charge pump current

	Mode	CP	T2	T1	T0
50uA	extended	0	1	1	0
125uA		0	1	1	1
250uA		1	1	1	0
650uA		1	1	1	1

		VHF	UHF	
50uA	extended			Center frequency
125uA		174~230MHz	471~600MHz	
250uA			601~730MHz	
650uA			731~860MHz	

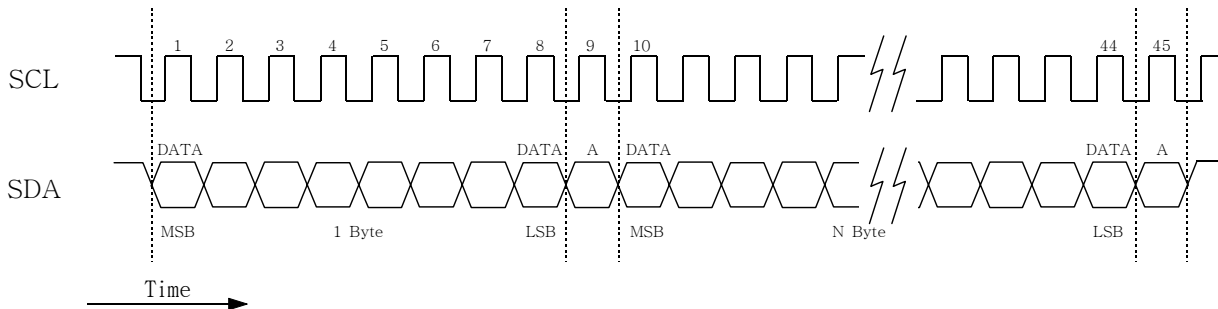
5-6. Band selection port

Band	P3	P2	P1	P0
VHF	0	0	1	0
UHF	1	0	0	0

5-7. Example for the I2C data stream to PLL

FREQUENCY	Address	177.5MHz		666MHz		850MHz	
WRITE REGISTOR(PLL)		DATA(Hex)		DATA(Hex)		DATA(Hex)	
Address Byte	0x58	C	2	C	2	C	2
Progr. Divider Byte 1	0x59	0	5	1	0	1	4
Progr. Divider Byte 2	0x5a	0	2	7	5	c	5
Control Byte 1	0x5b	b	4	f	4	f	c
Control Byte 2	0x5c	0	2	0	8	0	8

5-8. I²C bus data format



6. Safety and Reliability

NO	ITEM	TEST CONDITIONS	SPECIFICATIONS
6-1	COLD TEST	-40℃ ,168 HR	Gain Variation : $< \pm 3\text{dB}$ Wave Variation : $< \pm 30\%$ Local oscillator drift : VHF LOW : $\pm 15\text{KHz}$ VHF HIGH : $\pm 45\text{KHz}$ UHF : $\pm 75\text{KHz}$
6-2	HIGH TEMPERATURE LOAD TEST	+80℃ ,168 HR ,B+	
6-3	HUMIDITY TEST	+40℃ ,95%RH , 168 HR	
6-4	HUMIDITY & TEMPERATURE LOAD TEST	+40℃ ,95%RH , 168 HR ,B+	
6-5	PCT TEST	Pressure 2.07kg/cm ² , 121℃ 100%RH , 24HR	
6-6	VIBRATION TEST	Frequency ranging from 5 to 55Hz, amplitude 2mm, 40 minutes in each direction of X,Y,Z.	
6-7	STATIC ELECTRICITY TEST	①. Apply 8kV standard pulse 3 times at ANT. ②. Apply 2kV standard pulse 3 times at another pin.	
6-8	ESD protection	①.The tuner contains components that can be damaged by static discharge. ②.Observe these precautions. ③.Ground yourself before handling the tuner. ④.Do not touch the tuner connector pins without ESD protection.	

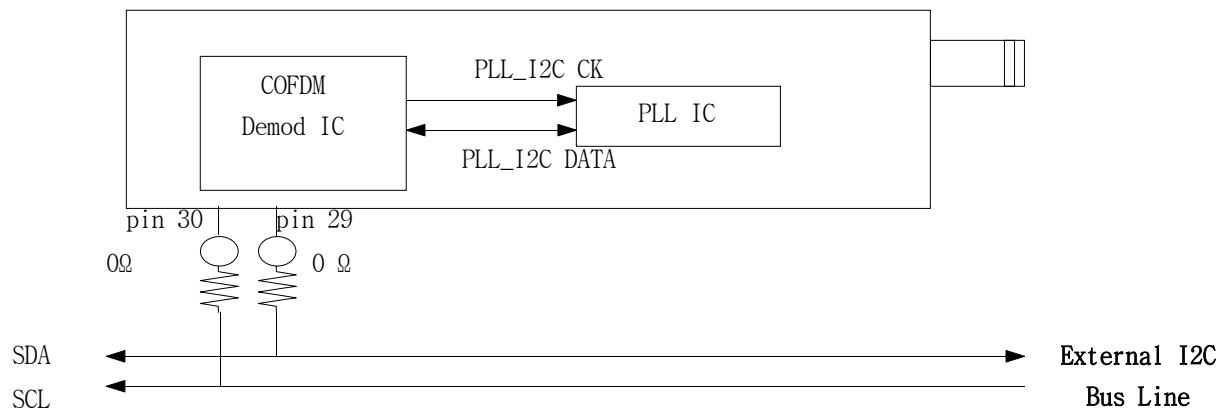
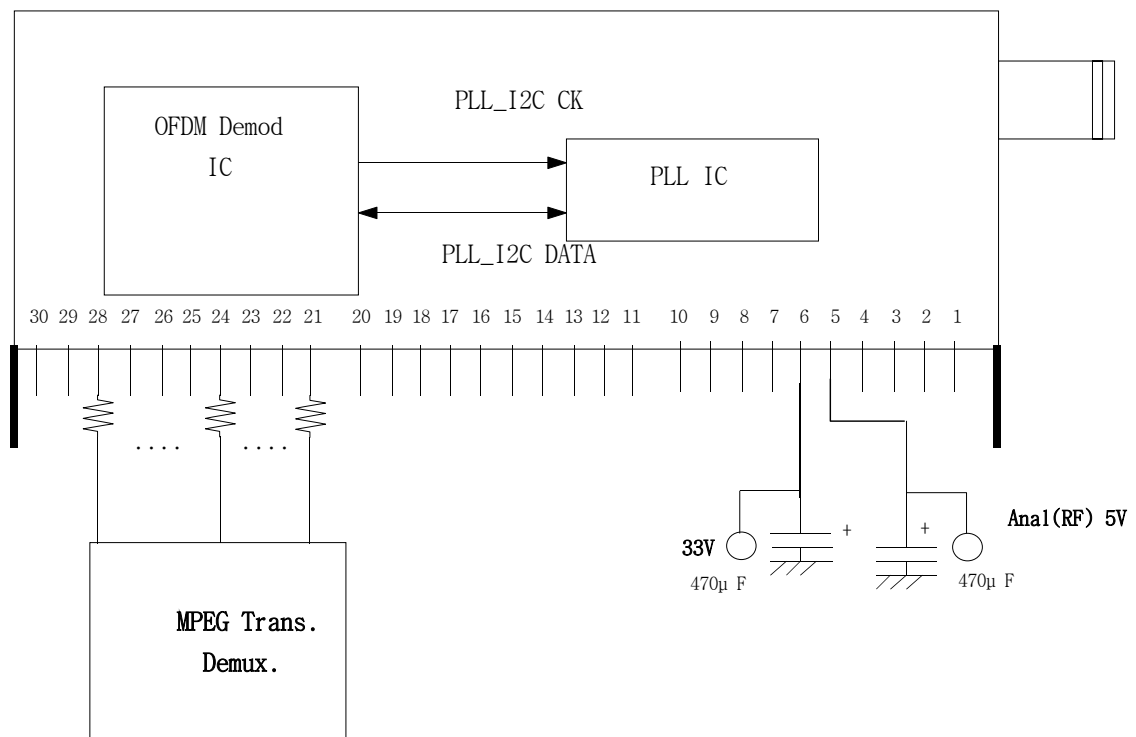


Fig.1 I2C Bus Mode



BASIC CIRCUIT CONNECT PIN DIAGRAM

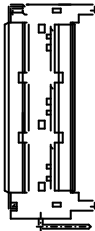
To reduce voltage source noise.

- i) Adding Capacitor(10n~100n), Inductor..
- ii) Ground should be seperated by the other Digital Noise.

Fig.4 Connect Diagram

A3



NO	PART NAME	Q'TY	MATERIAL	FINISH	REMARK
OUTDRAWING					
	NO	TERMINAL		NO	TERMINAL
	1	N.C		16	Reset
	2	N.C		17	Error Out
	3	N.C		18	Frame Sync
	4	RF AGC(N.C)		19	Valid
	5	5V		20	MPEG output Clock
	6	BT (33V)		21	MD0
	7	N.C		22	MD1
	8	N.C		23	MD2
	9	1'st IF(N.C)		24	MD3
	10	2'nd IF(N.C)		25	MD4
	11	Digital 5V		26	MD5
	12	Analogue 5V		27	MD6
	13	N.C		28	MD7
	14	Analogue 3.3V		29	SDA
15	Digital 3.3V		30	SCL	

REV.	DATE	WRITTEN BY	CHECKED BY	REVISION RECORD					REMARK
UNIT	$\frac{1}{1}$	DRAW	DESIGNED	CHECKED	APPROVED	NAME	PART NAME	OUTDRAWING	
SCALE	$\frac{1}{1}$	CAD	S.C.M	K.T.H	K.Y.J		MODEL NAME	OFDM-NIM	
TOLERANCE	± 0.5	2001	11.20				SEMCO P/N		
		File name							
ELECTRO-MECHANICS					3RD ANGLE PROJECTION		NO		