



SANYO Semiconductors

DATA SHEET



LV25450PNW

Bi-CMOS LSI

For Automotive Applications

DSP Tuner Front End

Overview

The LV25450PNW is a tuner front end IC that supports the Sanyo SDRS500 car radio DSP.

The LV25450PNW supports worldwide radio standards including the FM bands used in US, Europe, East-Europe, and Japan as well as the LW, MW, SW, and FM weather bands. It adopts an image canceling mixer for the FM mixer and incorporates a fast PLL locking function. The LV25450PNW also supports automatic alignment using CCB bus control. It requires external EEPROM.

The LV25450PNW can implement a DSP tuner at low cost with a minimal number of external components.

Functions

- AM,/FM-FE, IF, and PLL circuits

- CCB is a registered trademark of SANYO Electric Co., Ltd.
- CCB is SANYO Semiconductor's original bus format. All bus addresses are managed by SANYO Semiconductor for this format.

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Specifications

Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V _{CC} 8V	OSC_V _{CC} (3), IFAGC_V _{CC} (27), IFAGCOUT-Drive_V _{CC} (35), FE_V _{CC} (61)	9.0	V
	V _{CC} 5V	XTAL_V _{CC} (16), Digital_V _{CC} (25), Analog_V _{CC} (41)	6.0	V
CCB bus maximum input voltage	V _{IN} max	Pin 21, 22, 23	-0.3 to +5.0	V
CCB bus maximum output voltage	V _O	Pin 24	-0.3 to +6.5	V
Allowable power dissipation	P _d max	Ta ≤ 85°C *	850	mW
Operating temperature	Topr		-40 to +85	°C
Storage temperature	Tstg		-50 to +150	°C

* : Using the circuit board for the SANYO tuner module (specified board : 55mm × 39mm × 1.3mm, glass epoxy)

Recommended Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	V _{CC} 8V	OSC_V _{CC} (3), IFAGC_V _{CC} (27), IFAGCOUT-Drive_V _{CC} (35), FE_V _{CC} (61)	8.0	V
	V _{CC} 5V	XTAL_V _{CC} (16), Digital_V _{CC} (25), Analog_V _{CC} (41)	5	V
Operating supply voltage range	V _{CC} 8Vop		7.5 to 8.5	V
	V _{CC} 5Vop		4.5 to 5.5	V
CCB bus high-level input voltage	V _{IH}	CE, DI, CL	2.5 to 5.0	V
CCB bus low-level input voltage	V _{IL}	CE, DI, CL	0 to 0.8	V
CCB bus high-level input current	I _{IH}	CE, DI, CL ; VI5.5V	10 or less	μA
CCB bus low-level input current	I _{IL}	CE, DI, CL ; VI0V	10 or less	μA
DO low-level output voltage	V _{OL}		0.38 or less	V
DO high-level output voltage	V _{OH}	Connected to an LC75045.	2.1 or more	V

Reception Frequencies

Parameter	Symbol	Conditions	Frequency ratings	Unit
FM reception frequencies	f _{FM}	JPN, US, EU, E-EU	65 to 108.1	MHz
FM weather band reception frequencies	f _{FM-WB}		162.4 to 162.55	MHz
AM reception frequencies	f _{AMLW}	LW	144 to 288	kHz
	f _{AMMW}	MW	520 to 1710	kHz
	f _{AMSW}	SW	2.94 to 22.0	MHz

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Power on/Power off Timing and the Power on Reset

Recommended Operating Ratings at $T_a = 25^\circ\text{C}$, $\text{GND} = 0\text{V}$

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Operating supply voltage	Vcop H	Pin 3, 27, 35, 54, 55, 61	7.5		8.5	V
	Vcop L	Pin 16, 25, 41	4.5		5.5	V
Internal logic voltage	VREG3	Pin 26	2.7		3.3	V
	VREG4	Pin 15	3.7		4.3	V
Power application time (8.0 V \rightarrow 5.0 V)	T7		10		100	ms
Internal register retention voltage	Vhmin3	Pin 26 : Design reference value	VREG3		2.2	V
	Vhmin4	Pin 15 : Design reference value	VREG4		2.2	V
Internal register reset voltage	Voff	Pin 16, 25, 41 : Design reference value	0		0.2	V
Internal register reset power supply rise time	tPOR	Pin 16, 25, 41 : Design reference value	0.05		3	ms
Power application time (5.0 V \rightarrow 8.0 V)	T14		10		100	ms

Power-on Sequence and Power-on Reset

(1) Power on image and power on reset

Recommended Operating Ratings at $T_a = 25^\circ\text{C}$, $\text{GND} = 0\text{V}$

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Operating supply voltage	Vcop H	Pins 3, 27, 35, and 61	7.5		8.5	V
	Vcop L	Pins 16, 25, and 41	4.5		5.5	V
Internal logic voltage	VREG3	Pin 26	2.7		3.3	V
	VREG4	Pin 15	3.7		4.3	V
Internal register retention voltage	Vhmin3	Pin 26 : Design reference value	2.2		VREG3	V
	Vhmin4	Pin 15 : Design reference value	2.2		VREG4	V
Internal register reset voltage	Voff	Pins 16, 25, and 41 : Design reference value	0		0.2	V
Internal register reset power supply rise time	tPOR	Pins 16, 25, and 41 : Design reference value	0.05		3	ms

Note 1 : When reading out data from pin D0 connection (e.g., E2PROM) with the voltage at the pin 23 below 2.2V, be sure to read the data after transmitting the control data and pin D0 being set "open" because the state of internal register cannot be specified.

Note 2 : It is necessary to set data when power is first applied or there is a momentary power interruption.

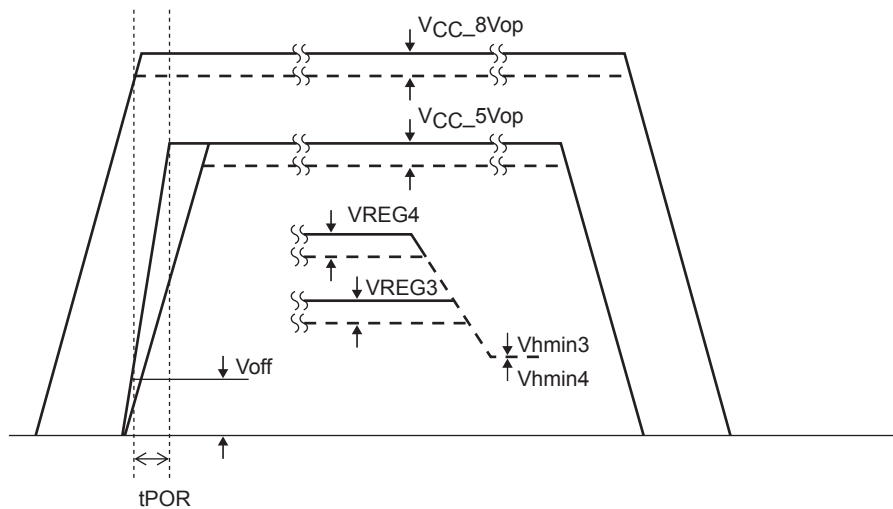


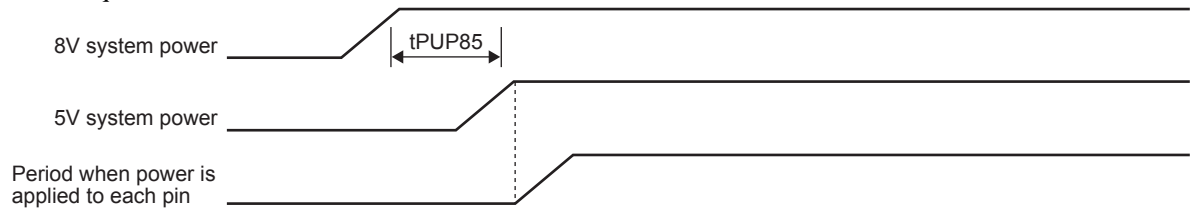
Image of Supply Voltage

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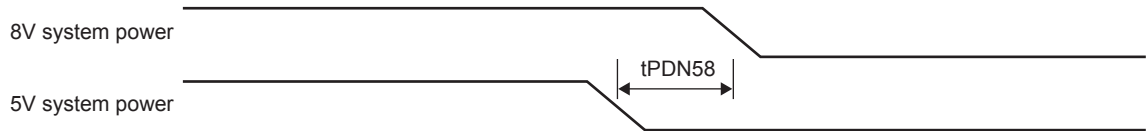
(2) Power on/off sequence

The power on and power off sequences for the IC must follow the order shown below.

- Power on sequence



- Power off sequence



Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Power on period (8V → 5V)	tPUP85		0		100	ms
Power off period (5V → 8V)	tPDN58		0		100	ms

Never apply power to the IC until all the supply voltages reach the predetermined values.

For pin D0, refer to the above section (1), Note 1, and Note 2.

Regarding voltage applied to each power pin, 8V system must always be higher than 5V system (8V system > 5V).

As long as this relationship is maintained and the power supply rise/fall time is within 100ms, there is no problem if the low voltage side power is started up first.

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AC Characteristics

Operating Characteristics at Ta = 25°C, VCC = 8.0V, VDD = 5.0V, unless otherwise specified. Ratings for publications

* : These measurements are made using the Yamaichi Electronics IC51-0644-807 IC socket. An IHF bandpass filter is used as the audio filter.

FM Characteristics - FM Front End Mixer Input (No dummy)

Parameter	Symbol	Conditions	Applied voltage				CCB Command				min	typ	max	unit
			Pin 28	Pin 34	Pin 50	Pin 2	IN1	IN2	IN3-1	IN3-2				
DC Characteristics														
Current drain-8V FM	ICCO-8V FM	No input, FM mode I3+I27+I355+I54+I55+I61	3				15	13	25	25	43.2	54	64.8	mA
Current drain-5V FM	ICCO-5V FM	No input, FM mode I16+I25+I41	3				15	13	25	25	20.8	26	31.2	mA
Regulator bias 3V	VREG3V	The pin 26 voltage	3				15	13	25	25	2.7	3	3.3	V
Regulator bias 4V	VREG4V	The pin 15 voltage	3				15	13	25	25	3.6	4	4.4	V
FM antenna dump output current	IANTD-F	The pin 64 output current (Pin 64 load = 100Ω +Pin_Diode × 2 when 6.0V is applied to pin 2	0	0		6	15	13	25	25	4.5	7.5	11	mA
AC Characteristics														
Crystal oscillator frequency	FXTAL	D2-7, 6, 5 = [100]	3				15	13	25	25		4.5		MHz
Crystal oscillator level	VXTAL	D2-7, 6, 5 = [100] (reference value) D32-08 = 0, D2-10, 9, 8 = [100]	3				15	13	25	25	15			mVrms
Crystal oscillator buffer level	VXTAL OSC OUT2	D2-7, 6, 5 = [100] (reference value) D32-08 = 0, D2-10, 9, 8 = [100]	3				15	13	25	25	115	165		mVrms
S-meter DC output * : Adjust the shifter-bits with a 50dBμV input so that Vsm is set to 2.15V.	VSMFM-1	10dBμV, the pin 34 DC output, no modulation	3				15	13	25	25B	0.65	0.95	1.25	V
	VSMFM-2	30dBμV, the pin 34 DC output, no modulation	3				15	13	25	25B	0.95	1.25	1.55	V
	VSMFM-3	50dBμV, the pin 34 DC output, no modulation	3				15	13	25	25B	2.10	2.15	2.20	V
	VSMFM-4	70dBμV, the pin 34 DC output, no modulation	3				15	13	25	25B	3.1	3.4	3.7	V
	VSMFM-5	90dBμV, the pin 34 DC output, no modulation	3				15	13	25	25B	3.7	4	4.3	V
Total gain from mixer to DIV IF amplifier	GMXDIV	FM_MIX_IN, DIV_OUT_IF (pin 32) Ratio of the input to output signal levels 98.1MHz mod = off, 70dBμV-Input	1.5				15	13	25	25	16	19	22	dB
DIV IF amplifier gain	GDIVIF	IF_N_IN1 (pin 46), DIV_OUT_IF (pin 32) Ratio of the input to output signal levels 10.7MHz mod = off, 88dBμV-Input	3				15	13	25	25	4.5	7.5	10.5	dB
1dB compression point driver IF	1DB POINT DIF	IF_N_IN1 (pin 46), DIV_OUT_IF (pin 32) Ratio of the input to output signal levels 10.7MHz mod = off	3				15	13	25	25		111		dB
Narrow IF AGC gain (FM)	GIFAGCNF1	FM_ANALOG_IN (pin 46), 10.7OUTN (pin 30) Ratio of the input to output signal levels 10.7MHz mod = off 100dBμV-Input D32-27 to 25 = 011	0				15	13	25	25	-4.5	-2.5	-0.5	dB
Narrow IF AGC gain (FM)	GIFAGCNF2	FM_ANALOG_IN (pin 46), 10.7OUTN (pin 30) Ratio of the input to output signal levels 10.7MHz mod = off 80dBμV-Input D32-27 to 25 = 011	3				15	13	25	25	23.5	25.5	27.5	dB
1dB compression point FM-Narrow	1DB POINT NF	FM_ANALOG_IN (pin 46), 10.7OUTN (pin 30) 10.7MHz mod = off D32-27 to 2] = 011	0				15	13	25	25	107			dBμV

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Parameter	Symbol	Conditions	Applied voltage				CCB Command				min	typ	max	unit
			Pin 28	Pin 34	Pin 50	Pin 2	IN1	IN2	IN3-1	IN3-2				
Image cancellation ratio (US)	IR US	98.1MHz reference, the amount rejected at +21.4MHz Trm-Bit D2-18=[0]:ON APF-ADJ D32-19 to 16=[1010]:10	1.5				15	21	25	58	30			dB
Image cancellation ratio (JPN)	IR JPN	83MHz reference, the amount rejected at -21.4MHz D1-28 to 26 = [010] Trm-Bit D2-18=[1]:OFF APF-ADJ D32-19 to 16=[1000]:8	1.5				22	13	27	25	25			dB
FM wide AGC on sensitivity F1	WAGC ON-F1	fr = 102.1MHz FM-Wide AGC-Bit D32-3 to 0 = [0000] : minimum	0	3			15	13	25	13	78	85	92	dB μ V
FM wide AGC on sensitivity F2	WAGC ON-F2	fr = 102.1MHz FM-Wide AGC-Bit D32-3 to 0 = [1111] : maximum	0	3			15	13	25	15	92	99	106	dB μ V
FM narrow AGC on sensitivity F1	NAGC ON-F1	fr = 98.1MHz FM-Narrow AGC-Bit D32-7 to 4 = [0000] : minimum	0	3			15	13	25	16	70	77	84	dB μ V
FM narrow AGC on sensitivity F2	NAGC ON-F2	fr = 98.1MHz FM-Narrow AGC-Bit D32-7 to 4 = [1111] : maximum	0	3			15	13	25	18	86	93	100	dB μ V
Practical sensitivity	S/N-31	Connected to an LA1787 (MPX, left channel output) *HCC OFF 98.1MHz, 31dB μ V, fm = 1kHz, 22.5kHz-mod 62/63pin input	3				15	13	25	25	30			dB
Signal-to-noise ratio	S/N-90	Connected to an LA1787 (MPX, left channel output) 98.1MHz, 90dB μ V, fm = 1kHz, 22.5kHz-mod 62/63pin input	0				15	13	25	25	54	57		dB

AM Characteristics : AM, AM-ANT inputs

Parameter	Symbol	Conditions	Applied voltage				CCB Command				min	typ	max	unit
			Pin 28	Pin 34	Pin 50	Pin 2	IN1	IN2	IN3-1	IN3-2				
DC Characteristics														
Current drain-8V AM	I _{CCO-8V AM}	No input, AM mode I3+I27+I35+I54+I55+I61	3				33	15	26	26	36	46	56	mA
Current drain-5V AM	I _{CCO-5V AM}	No input, AM mode I16+I25+I41	3				33	15	26	26	15	19	23	mA
AM antenna dump output current	IANTD-A	When pin 50 is connected to ground The ANT-D (pin 52) output current	3	0			33	15	26	26	3.5	6	9	mA
AC Characteristics														
First AM amplifier gain	GAMP1	FM_N_IN1 (pin 46) IF_OUT (pin 44), after CF matching, 10.7MHz mod = off 74dB μ V = Input	0				33	15	26	26	5.2	6.2	7.2	dB
Narrow IF AGC gain (AM)	GIFAGCNA1	AM_ANALOG_IN (pin 39), 10.7OUTN (pin 30) Ratio of the input to output signal levels 10.7MHz mod = off 100dB μ V-Input D32-27 to 25 = [011]	0				33	15	26	26	-4.5	-2.5	-0.5	dB
Narrow IF AGC gain (AM)	GIFAGCNA2	AM_ANALOG_IN (pin 39), 10.7OUTN (pin 30) Ratio of the input to output signal levels 10.7MHz mod = off 80dB μ V-Input D32-27 to 25 = [011]	3				33	15	26	26	23.5	25.5	27.5	dB
1dB compression point AM - narrow	1DB POINT NA	AM_ANALOG_IN (pin 39), 10.7OUTN (pin 30) 10.7MHz mod = off D32-27 to 25 = [011]	0				33	15	26	26	107			dB μ V

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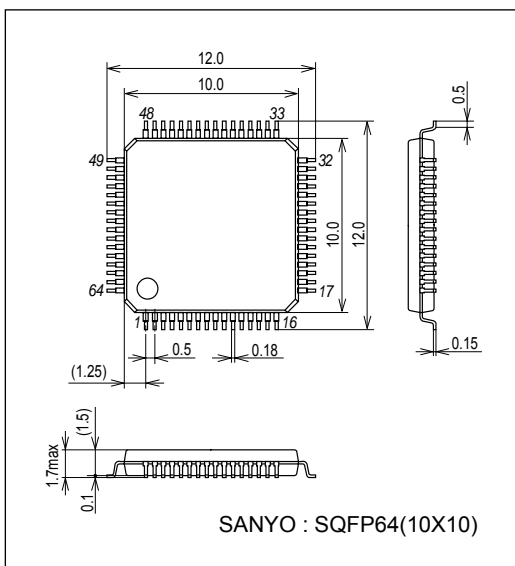
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Parameter	Symbol	Conditions	Applied voltage				CCB Command				min	typ	max	unit
			Pin 28	Pin 34	Pin 50	Pin 2	IN1	IN2	IN3-1	IN3-2				
AM wide-AGC on sensitivity A1	WAGC ON-A1	AM-ANT-IN = 1.4MHz, mod = off The input level such that the ANT_D (pin 52) level becomes 0.5V. AM wide AGC-Bit D32-3 to 0 = [0000]	0				33	15	26	27	78.5	83.5	88.5	dB μ V
AM wide AGC on sensitivity A2	WAGC ON-A2	AM-ANT-IN = 1.4MHz, mod = off The input level such that the ANT_D (pin 52) level becomes 0.5V. AM wide AGC-Bit D32-3 to 0 = [1101]	0				33	15	26	29	92	97	102	dB μ V
AM narrow AGC on sensitivity A1	NAGC ON-A1	AM-ANT-IN = 1MHz, mod = off The input level such that the ANT_D (pin 52) level becomes 0.5V. AM narrow AGC-Bit D32-7 to 4 = [0000]	0				33	15	26	30	60	65	70	dB μ V
AM narrow AGC on sensitivity A2	NAGC ON-A2	AM-ANT-IN = 1MHz, mod = off The input level such that the ANT_D (pin 52) level becomes 0.5V. AM narrow AGC-Bit D32-7 to 4 = [1111]	0				33	15	26	32	75	80	85	dB μ V
Total AM gain	AMGAIN	1MHz, 60dB μ V, mod = off, the ration of the AM_ANT input and the 10.7OUTN (pin 30) output levels	3				33	15	26	26	36	41	46	dB
Practical sensitivity	S/N-33	With an LA1787 connected With a 1MHz, 33dB μ V, fm = 1kHz, 30% modulation ANT input and the IF AGC voltage = 3V add.	3				33	15	26	26	20			dB
AM-THD	THD-74	With an LA1787 connected With a 1MHz, 74dB μ V, fm = 1kHz, 80% modulation ANT input and the IF AGC voltage adjusted so that the IFAGCOUT level is 100dB μ V.	Adjusted				33	15	26	26		0.7	1.0	%
Signal-to-noise ratio	S/N-74	With an LA1787 connected With a 1MHz, 74dB μ V, fm = 1kHz, 30% modulation ANT input and the IF AGC voltage adjusted so that the IFAGCOUT level is 100dB μ V.	Adjusted				33	15	26	26	52.5	56		dB

Package Dimensions

unit : mm (typ)

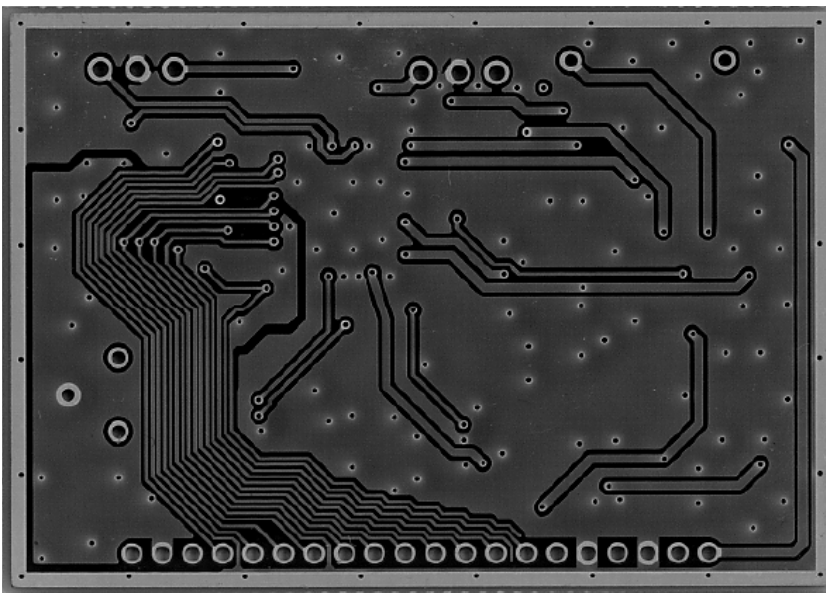
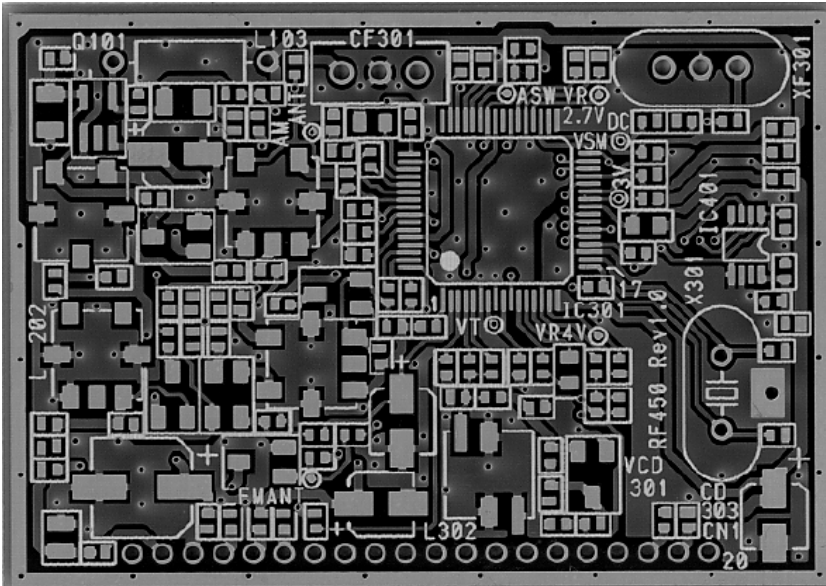
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LV25450PNW

Power dissipation test board

Material : Glass epoxy resin
Conditions : Double-sided circuit board, without chassis
Board size : 55mm × 39mm × 1.3mm



* Ratings for LV25450PNW power dissipation is measured using the above circuit board.

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Pin Functions

Pin No.	Pin Name	Pin No.	Pin Name
1	FE_GND	33	IFAGCOUT-Drive GND
2	FM-RF-AGC	34	VSM_DC
3	Local-OSC-V _{CC} 8V	35	IFAGCOUT-Drive V _{CC}
4	Local-OSC (B)	36	VREG2.7V
5	Local-OSC (C)	37	Analog_GND
6	Local-OSC_GND	38	AM ANALOG IN Bypass
7	VT (LPF)	39	AM ANALOG IN
8	FET_GND	40	(non-connection)
9	PLL-LPF_AM	41	Analog_V _{CC} 5V
10	FM_FET_OUT	42	AM_N-AGC pick-up
11	AM_FET_OUT	43	Address-SW
12	AM_CP OUT	44	AM 1stIF_AMP_OUT
13	FM_CP OUT	45	VREG4.9V
14	Digital_GND	46	IF-IN-N1 (CF = 180k)
15	VREG 4V	47	IF-IN-N_Bypass
16	Xtal-V _{CC} 5V	48	(non-connection)
17	XTAL-IN	49	AM-W-AGC
18	XTAL-OUT	50	AM-RF-AGC
19	Xtal-GND	51	AM RF-AGC (Bypass)
20	XTAL_OSC_OUT2	52	AM-ANT-D
21	CE	53	FM N-AGC-IN
22	DI	54	MIX-OUT
23	CL	55	MIX-OUT
24	DO	56	ANT-DAC
25	Digital_V _{CC} 5V	57	RF-DAC
26	VREG 3V	58	(non-connection)
27	IFAGCAMP_V _{CC} 8V	59	AM-MIX-IN2 (Bypass)
28	AGC_DAC_S (fromDSP)	60	AM-MIX-IN1
29	IFAGCAMP_GND	61	FE V _{CC} 8V
30	IFAGC-OUT (10.7MHz) N	62	FM-MIX-IN1
31	IFAGC-OUT (10.7MHz) P	63	FM-MIX-IN2
32	DIV_IF-OUT	64	FM-ANT-D

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Functions

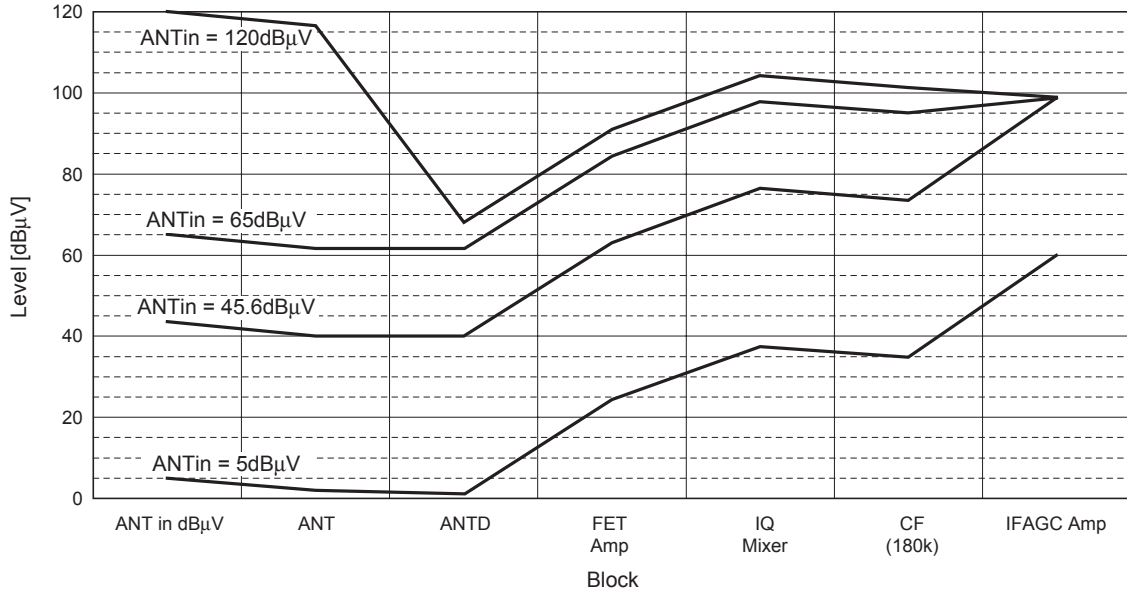
AM/FM front-end AGC block		
FM Image rejection Mixer (IQ-MIX)	Gain switching : 1 bit	
FM IQ-MIX phase adjust (For the Japanese FM band)		
Injection switching	1 bit	for East Band Receive
AM Double balance Mixer		
Pin diode drive AGC output (AM/FM)		
Wide AGC sensitivity setting (AM/FM)	4 bit DAC	
Narrow AGC sensitivity setting (AM/FM)	4 bit DAC	
Keyed AGC adjust (FM)	4 bit DAC	
AM RF AGC	4 bit DAC	
Local oscillator	133MHz to 262MHz	
Local osc divider (FM/AM)	Division by 1, 2, or 3	
Local osc divider (AM)	Division by 20, 16, 12, or 8	
ANT/RF DAC (FM)	9 bit DAC × 2	
AM 1st IF AMP block		
1st-IF amplifier 10.7M		
IF-Lim-Amp/S-meter block		
S-meter shifter	5 bit DAC	
IF Limiter Amplifier 6 stage		for FM-S-meter
S-meter (DC for keyed AGC) (FM)		
IF-AGC-Amp/IF-Amp for Diversity block		
IF AGC Amplifier (control Voltage from DSP)		
IF output Driver for DSP	10.7MHz IF	
IFAGC-Amp Gain Adjust.		
IF-Amplifier for Diversity (Fixed Gain)	10.7MHz IF	
IF-Output Driver for DIV-IF	10.7MHz IF	
PLL		
Fast lock PLL		
Filter SW		
Charge-Pump switching		
other		
Tuner off	1 bit SW	
2.7V Regulator adjust	2 bit DAC	

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LV25450PNW Level Diagrams

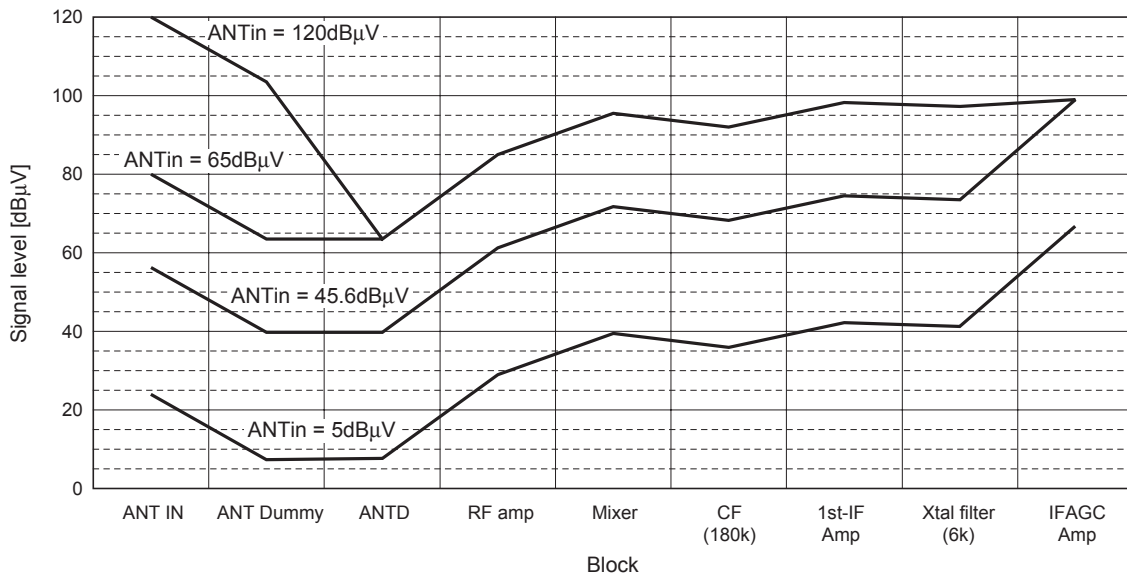
FET : FET Application		-3.5	0	22.9	13.5	-3	25.5	55.4
FM (FET) Gain Down	ANT in dB μ V	ANT	ANTD	FET Amp	IQ Mixer	CF (180k)	IFAGC Amp	Total Gain
Near practical sensitivity	5.0	1.5	1.5	24.4	37.9	34.9	60.4	
IFAGC-ON	43.6	40.1	40.1	63.0	76.5	73.5	99.0	
RFAGC-ON	65.0	61.5	61.5	84.4	97.9	94.9	99.0	
Strong input signal	120.0	116.5	68.1	91.0	104.5	101.5	99.0	

FM Level Diagram

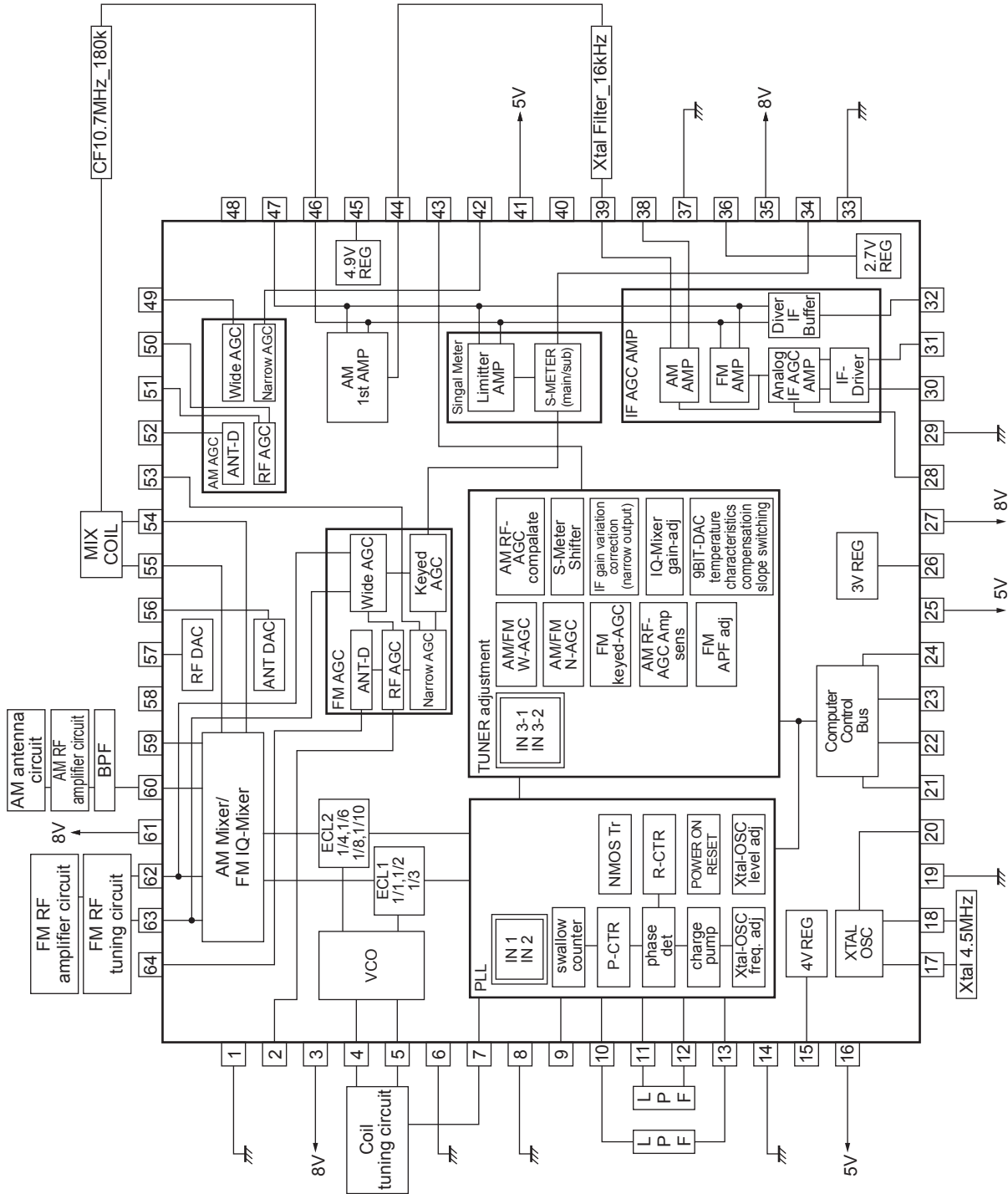


AM		Full Gain	-16.5	0	21.5	10.5	-3.5	6.2	-1	25.5
	ANT IN	ANT Dummy	ANTD	RF amp	Mixer	CF (180k)	1st-IF Amp	Xtal filter (6k)	IFAGC Amp	
Near practical sensitivity	24	7.5	7.5	29	39.5	36	42.2	41.2	66.7	
IFAGC-ON	56.3	39.8	39.8	61.3	71.8	68.3	74.5	73.5	99	
RFAGC-ON	80	63.5	63.5	85	95.5	92	98.2	97.2	99	
Strong input signal	120	103.5	63.5	85	95.5	92	98.2	97.2	99	

AM Level Diagram



Block Diagram



LV25450PNW

Pin Description

Pin No.	Pin Function	Description	Equivalent Circuit
1	FE.GND	Front-end block GND	
2	FM-RF-AGC	FM RF AGC voltage output	
3	Local-OSC-V _{CC} 8V	Local oscillator system power supply	
4	Local-OSC (B)	Oscillator pins	
5	Local-OSC (C)		
6	Local-OSC-GND	Local oscillator system GND	
7	VT (LPF)		
8	FET_GND	Active filter FET GND in the PLL circuit block	
9	PLL-LPF_AM		
10	FM_FET_OUT		

Continued on next page.

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Continued from preceding page.

Pin No.	Pin Function	Description	Equivalent Circuit
11	AM_FET_OUT		
12	AM_CP OUT		
13	FM_CP OUT		
14	Digital_GND	Digital system GND	
15	VREG 4V	Dedicated swallow counter 4V regulator voltage smoothing	
16	Xtal-V _{CC} 5V	Dedicated crystal oscillator power supply	
17	XTAL-IN	Connect a 4.5MHz crystal resonator between pins 17 and 18.	
18	XTAL-OUT	Connect a 10pF capacitor between pin 17 and GND, and a 150pF capacitor between pin 18 and GND.	
19	Xtal-GND	Dedicated crystal oscillator GND	

Continued on next page.

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Continued from preceding page.

Pin No.	Pin Function	Description	Equivalent Circuit
20	XTAL_OSC_OUT2	Pin 20: clock signal output for 2-tuner	
21	CE	Serial data input (DE) to the LV25450PNW. Force the output to the high level during serial data output (DO).	
22	DI	Input for the serial data transferred to the LV25450PNW from the controller.	
23	CL	Clock used for synchronization when serial data is input to the LV25450PNW (DI) or when serial data is output (DO).	

Continued on next page.

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Continued from preceding page.

Pin No.	Pin Function	Description	Equivalent Circuit
24	DO	Output for data transferred to the controller by the LV25450PNW	
25	Digital_VCC 5V	Digital system power supply	
26	VREG3V	3V regulator output for PLL power supply	
27	IFAGCAMP_VCC 8V	IF (10.7MHz) signal system power supply	
28	AGC_DAC_S	IF AGC control bias is supplied from the LC7504x (for the analog system).	
29	IFAGCAMP_GND	IF (10.7MHz) signal system GND	

Continued on next page.

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Continued from preceding page.

Pin No.	Pin Function	Description	Equivalent Circuit
30	IFAGC-OUT (10.7MHz) N	Narrowband IF (10.7MHz) signal differential output to the LC7504x for analog use.	
31	IFAGC-OUT (10.7MHz) P	Narrowband IF (10.7MHz) signal differential output to the LC7504x for analog use.	
32	DIV_IF-OUT	Driver 10.7MHz signal buffer output	
33	IFAGCOUT-Drive GND	Dedicated IFAGC output driver GND	
34	VSM_DC	Current driver S-meter output AC components are removed with an external capacitor.	

Continued on next page.

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Continued from preceding page.

Pin No.	Pin Function	Description	Equivalent Circuit
35	IFAGCOUT-Drive V_{CC}	Dedicated IFAGC output driver V_{CC}	
36	VREG2.7V	2.7V internal regulator output (smoothing)	
37	Analog_GND	Analog system GND	
38	AM ANALOG IN Bypass	Pin 39 : AM analog signal input to the AM IFAGC amplifier. (AM 10.7MHz IF signal) Pin 38 : Connected to ground with an external bypass capacitor.	
39	AM ANALOG IN		
40	N.C.		
41	Analog_ V_{CC} 5V	Analog system power supply	
42	AM Narrow-AGC Pick-Up	AM narrow AGC detection input	
43	Address_SW	When two tuners are used, one (for substitute) of the two ICs' pin 43 is connected to ground, need changes the address.	

Continued on next page.

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Continued from preceding page.

Pin No.	Pin Function	Description	Equivalent Circuit
44	AM 1stIF_AMP_OUT	First AM IF amplifier output	
45	VREG4.9V	4.9V internal regulator output (smoothing)	
46	IF-IN-N1	First AM IF amplifier input	
47	IF-IN-N_Bypass	Driver 10.7MHz signal buffer input FM limiter amplifier input	
48	N.C.		
49	AM-W-AGC	AM wide AGC pickup	

Continued on next page.

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Continued from preceding page.

Pin No.	Pin Function	Description	Equivalent Circuit
50	AM-RF-AGC	RF AGC rectifying capacitor Determines the distortion for low-frequency modulation. Increasing the size of C50 : Distortion → Improves Response → Becomes slower Reducing the size of C50 and C 51 : Distortion → Degrades Response → Becomes faster	
51	AM-RF-AGC (Bypass)	Reducing the size of C51 : Distortion → Degrades Response → Becomes faster	
52	AM-ANT-D	Provides the PIN diode drive current. This is the antenna dumping current output.	
53	FM N-AGC-IN	FM narrow AGC input	
54	MIX-OUT	Mixer output (common to FM and AM)	
55	MIX-OUT		

Continued on next page.

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Continued from preceding page.

Pin No.	Pin Function	Description	Equivalent Circuit
56	ANT-DAC	Antenna tuning circuit adjustment D/A converter output (9-bit D/A converter)	
57	RF-DAC	RF tuning circuit adjustment D/A converter output (9-bit D/A converter)	
58	N.C.		
59 60	AM MIX-IN2 (Bypass) AM MIX-IN1	AM mixer input Input impedance : 10kΩ	
61	FE V _{CC} 8V	Front-end block power supply	
62 63	FM MIX-IN1 FM MIX-IN2	FM mixer input FM wide AGC pickup Input impedance : 10kΩ	

Continued on next page.

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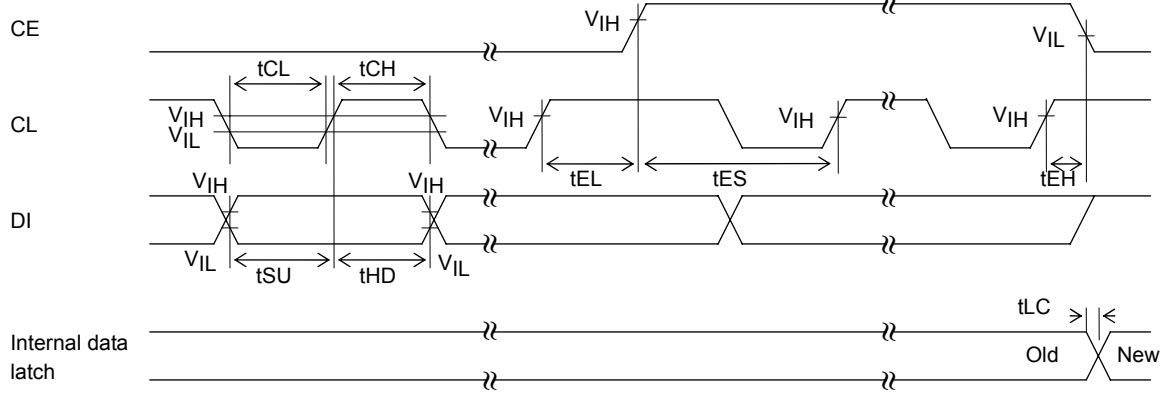
Continued from preceding page.

Pin No.	Pin Function	Description	Equivalent Circuit
64	FM ANT D	Pin 64 : The antenna driving current flows when the RF AGC voltage reaches $(V_{CC} - V_{be})$.	

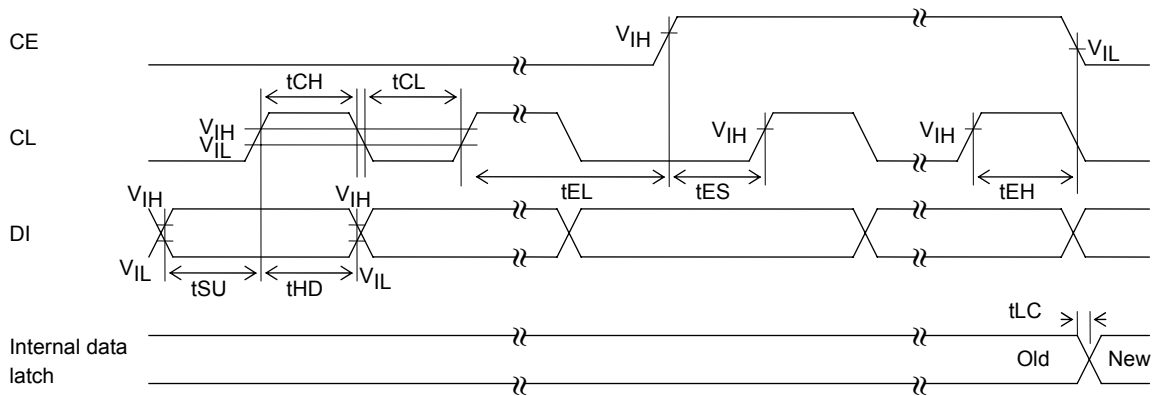
LV25450PNW

Serial Bus Data Timing

- CE : Chip enable
- CL : Clock
- DI : Data input
- DO : Data output (pin information only)



《《 When CL is stopped at the L level 》》



《《 When CL is stopped at the H level 》》

Parameter	Symbol	Pin	Conditions	min	typ	max	unit
Data setup time	tSU	DI, CL		0.45			μs
Data hold time	tHD	DI, CL		0.45			μs
Clock L-level time	tCL	CL		0.45			μs
Clock H-level time	tCH	CL		0.45			μs
CE wait time	tEL	CE, CL		0.45			μs
CE setup time	tES	CE, CL		0.45			μs
CE hold time	tEH	CE, CL		0.45			μs
Data latch change time	tLC					0.45	μs
Data input high-level voltage	V _{IH}	CL, DI, CE		2.5		5.0	V
Data input low-level voltage	V _{IL}	CL, DI, CE		0		0.8	V

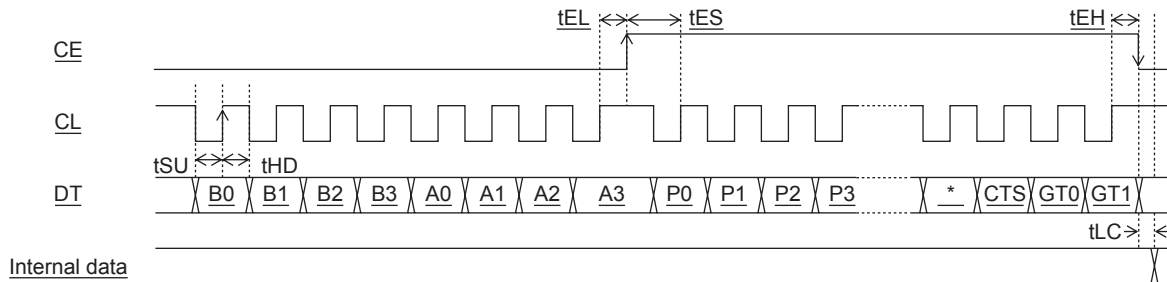
LV25450PNW

Serial Data I/O Procedures

The LV25450PNW uses the SANYO audio IC serial bus format. Data is input and output using a CCB (Computer Control Bus). The LV25450PNW adopts an 8-bit address version of the CCB format.

	I/O mode	Address								Contents
		B0	B1	B2	B3	A0	A1	A2	A3	
[1]	IN1	0	0	0	1	0	1	0	0	<ul style="list-style-type: none"> • Control data input mode. PLL setup • 32 bits of data are input • IN1B is the 2-tuner mode address (when pin 43 is tied to ground)
	IN1B	0	1	0	1	0	1	0	0	
[2]	IN2	1	0	0	1	0	1	0	0	<ul style="list-style-type: none"> • Control data input mode. PLL setup • 32 bits of data are input • IN2B is the 2-tuner mode address (when pin 43 is tied to ground)
	IN2B	1	1	0	1	0	1	0	0	
[3]	IN3	1	0	0	1	0	1	1	0	<ul style="list-style-type: none"> • The tuner block is set up in control data input (serial data input) mode. • 32 bits of data are input - There is a sub-address • IN3B is the 2-tuner mode address (when pin 43 is tied to ground)
	IN3B	0	0	0	1	0	1	1	0	

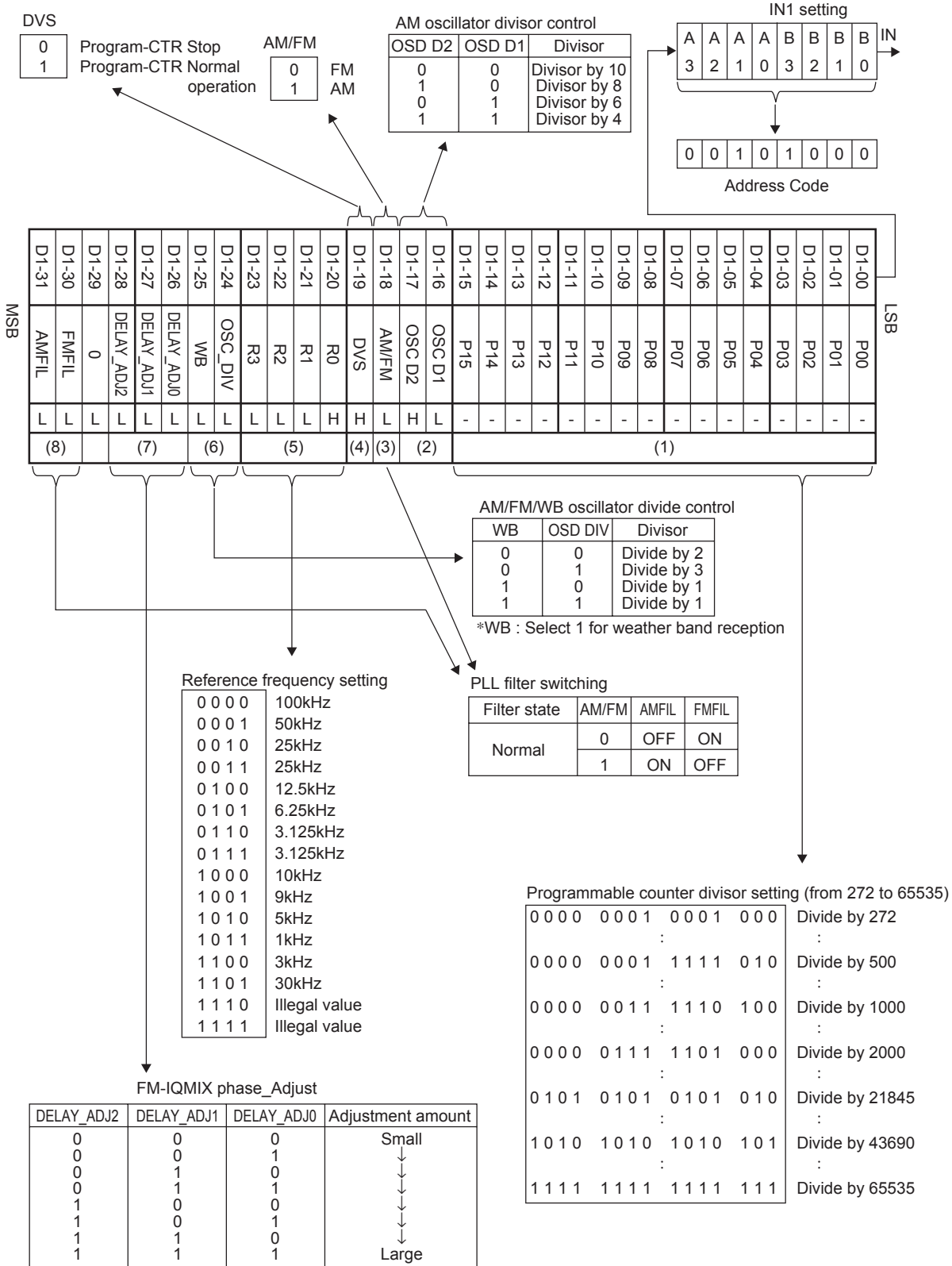
i) Serial data inputs (IN1/IN2/IN3) $t_{SU}, t_{HD}, t_{ES}, t_{EL}, t_{EH} > 0.45\mu s$ $t_{LC} < 0.45\mu s$



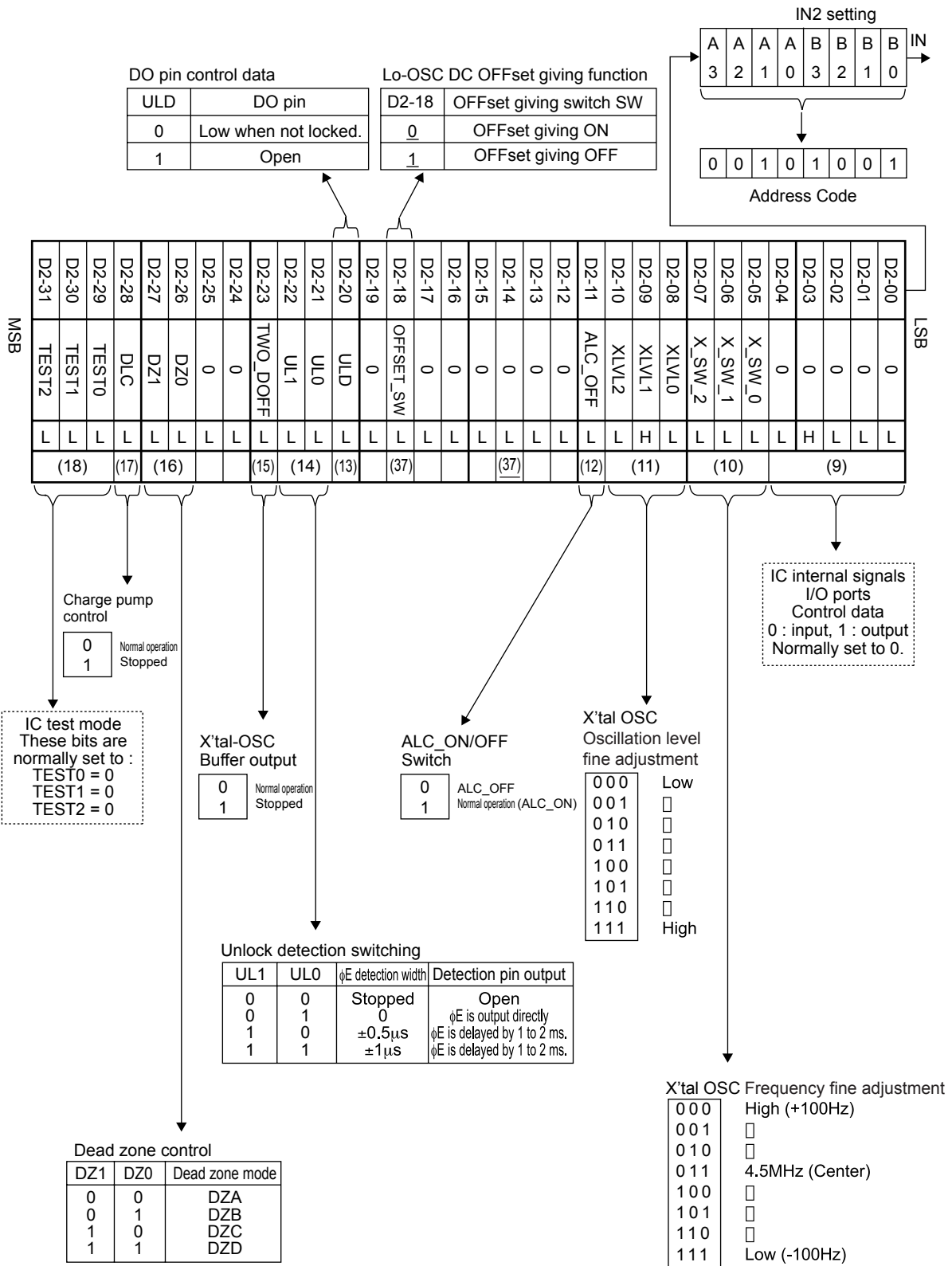
(*1) Since the DO pin is an N-channel open drain circuit, the times for the data to change will differ depending on the value of the pull-up resistor and printed circuit board capacitance.

(*2) The DO pin is normally left open.

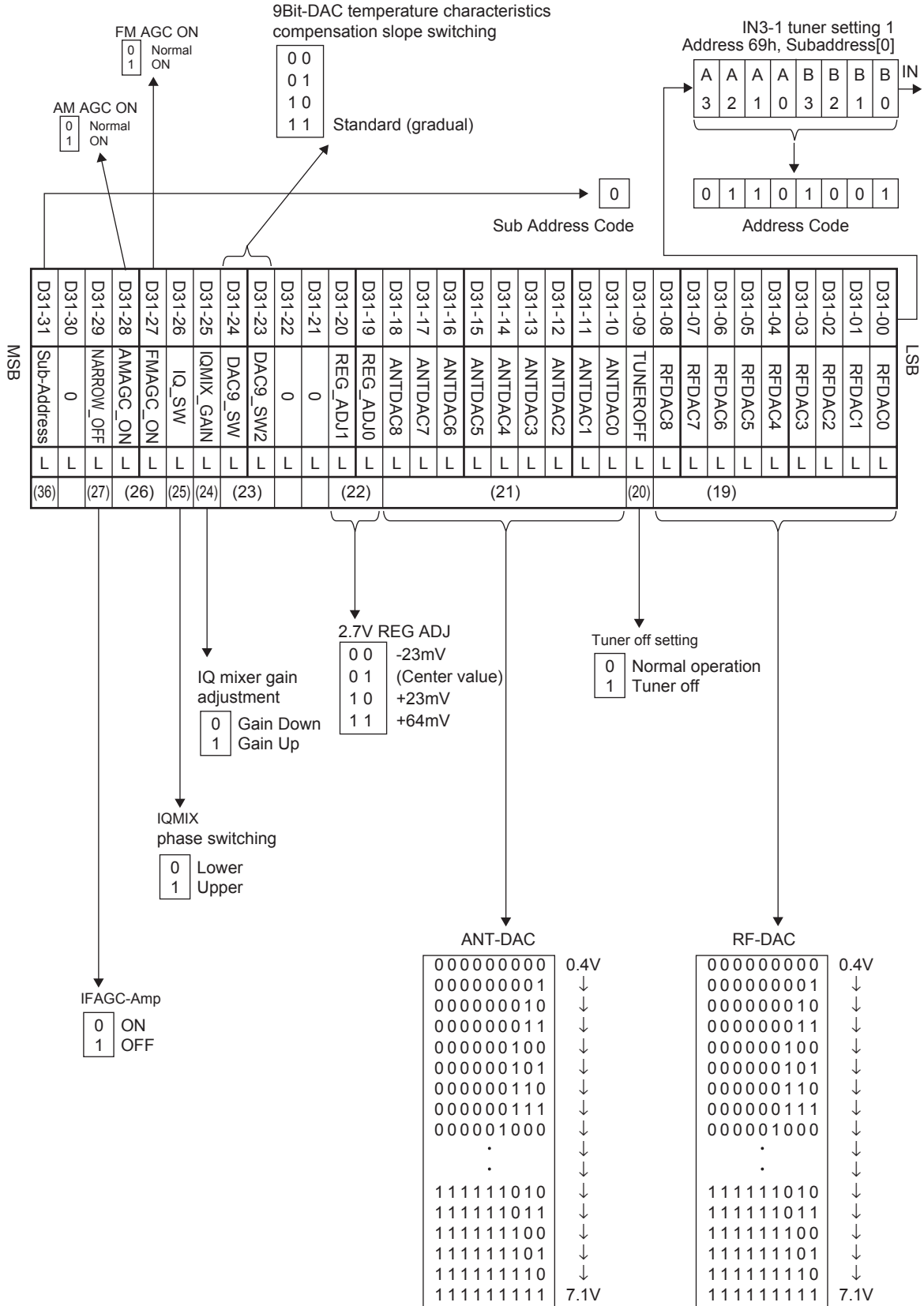
LV25450PNW



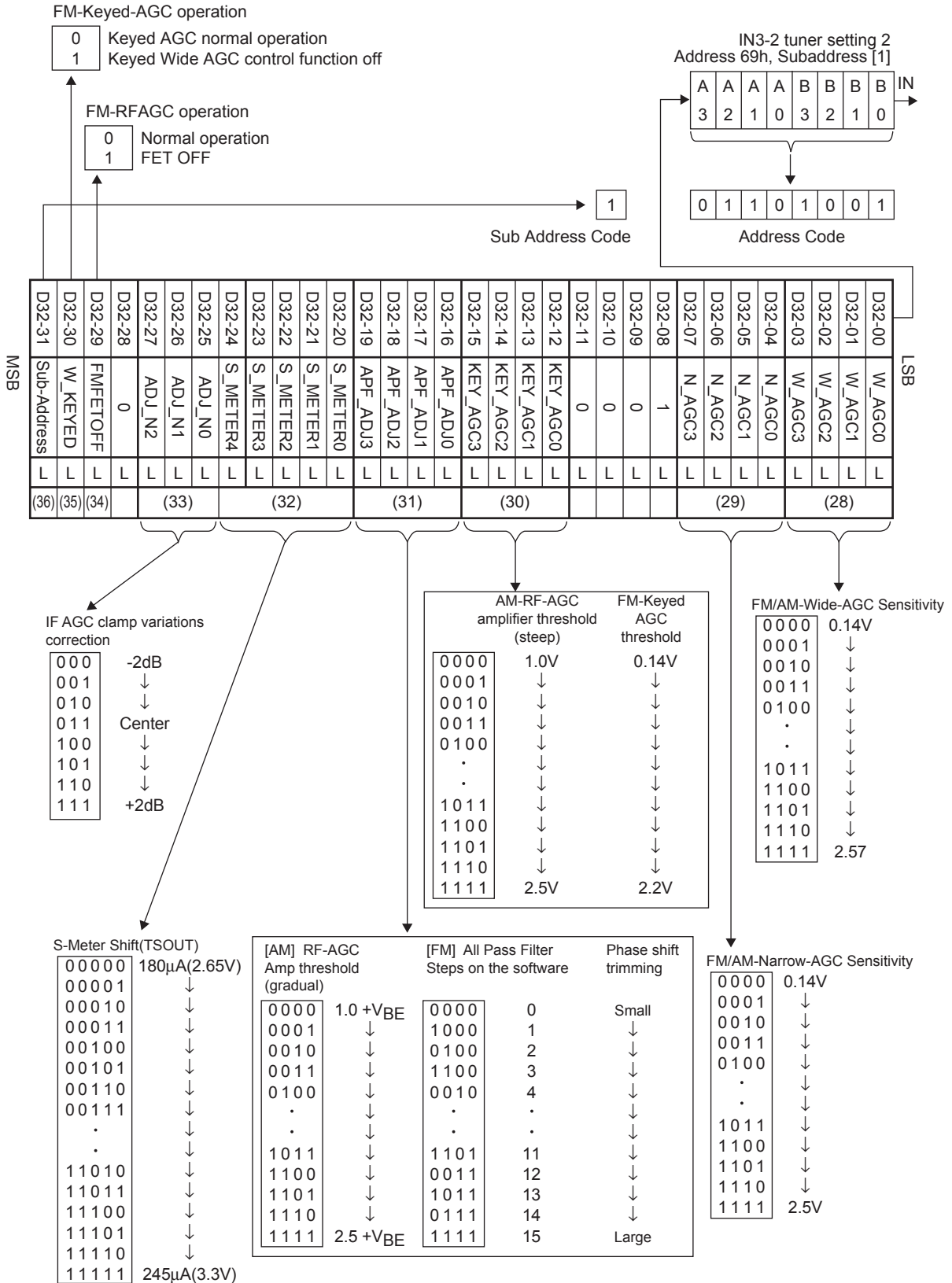
LV25450PNW



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Control Data Documentation

No.	Control block/data	Description	Related data																																																																																										
(1)	Programmable divider data P0 to P15 DVS	<ul style="list-style-type: none"> • Sets the programmable divider's divisor. This is a binary value in which P0 is the LSB, P15 the MSB. DVS = 0 : The IC internal PLL IN pin is stopped (pulled down) DVS = 1 : The IC internal PLL IN pin is selected Set divisor (N) : 272 to 65536 Input frequency range : 120 to 270 MHz * : See the "Programmable Divider Structure" section for more information. 	AM/FM OSC D1, D2 WB, OSC DIV																																																																																										
(2)	AM oscillator divisor control OSC D1, OSC D2	<ul style="list-style-type: none"> • OSC D1, OSC D2-AM oscillator divisor control <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>OSC D1</th> <th>OSC D2</th> <th>Divisor</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>Divide by 10</td> </tr> <tr> <td>0</td> <td>1</td> <td>Divide by 8</td> </tr> <tr> <td>1</td> <td>0</td> <td>Divide by 6</td> </tr> <tr> <td>1</td> <td>1</td> <td>Divide by 4</td> </tr> </tbody> </table>	OSC D1	OSC D2	Divisor	0	0	Divide by 10	0	1	Divide by 8	1	0	Divide by 6	1	1	Divide by 4	AM/FM P0 to P15																																																																											
OSC D1	OSC D2	Divisor																																																																																											
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1	1	Divide by 4																																																																																											
(3)	Tuner mode switching AM/FM	<ul style="list-style-type: none"> • Tuner mode switching between AM and FM 1 = AM 0 = FM 	P0 to P15 OSC D1, D2																																																																																										
(4)	Programmable divider stop DVS	<ul style="list-style-type: none"> • DVS = 0 : The IC internal PLL-IN pin is stopped (pulled down) DVS = 1 : The IC internal PLL-IN pin is selected Set divisor (N) : 272 to 65536 Input frequency range : 120 to 270 MHz * : See the "Programmable Divider Structure" section for more information. 																																																																																											
(5)	Reference divider data R0 to R3	<ul style="list-style-type: none"> • Selects the reference frequency. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th colspan="4"></th> <th>Reference frequency setting (kHz)</th> </tr> <tr> <th>R3</th> <th>R2</th> <th>R1</th> <th>R0</th> <th>Crystal : 4.5MHz</th> </tr> </thead> <tbody> <tr><td>0</td><td>0</td><td>0</td><td>0</td><td>100</td></tr> <tr><td>0</td><td>0</td><td>0</td><td>1</td><td>50</td></tr> <tr><td>0</td><td>0</td><td>1</td><td>0</td><td>25</td></tr> <tr><td>0</td><td>0</td><td>1</td><td>1</td><td>25</td></tr> <tr><td>0</td><td>1</td><td>0</td><td>0</td><td>12.5</td></tr> <tr><td>0</td><td>1</td><td>0</td><td>1</td><td>6.25</td></tr> <tr><td>0</td><td>1</td><td>1</td><td>0</td><td>3.125</td></tr> <tr><td>0</td><td>1</td><td>1</td><td>1</td><td>3.125</td></tr> <tr><td>1</td><td>0</td><td>0</td><td>0</td><td>10</td></tr> <tr><td>1</td><td>0</td><td>0</td><td>1</td><td>9</td></tr> <tr><td>1</td><td>0</td><td>1</td><td>0</td><td>5</td></tr> <tr><td>1</td><td>0</td><td>1</td><td>1</td><td>1</td></tr> <tr><td>1</td><td>1</td><td>0</td><td>0</td><td>3</td></tr> <tr><td>1</td><td>1</td><td>0</td><td>1</td><td>30</td></tr> <tr><td>1</td><td>1</td><td>1</td><td>0</td><td>Illegal value</td></tr> <tr><td>1</td><td>1</td><td>1</td><td>1</td><td>Illegal value</td></tr> </tbody> </table>					Reference frequency setting (kHz)	R3	R2	R1	R0	Crystal : 4.5MHz	0	0	0	0	100	0	0	0	1	50	0	0	1	0	25	0	0	1	1	25	0	1	0	0	12.5	0	1	0	1	6.25	0	1	1	0	3.125	0	1	1	1	3.125	1	0	0	0	10	1	0	0	1	9	1	0	1	0	5	1	0	1	1	1	1	1	0	0	3	1	1	0	1	30	1	1	1	0	Illegal value	1	1	1	1	Illegal value	
				Reference frequency setting (kHz)																																																																																									
R3	R2	R1	R0	Crystal : 4.5MHz																																																																																									
0	0	0	0	100																																																																																									
0	0	0	1	50																																																																																									
0	0	1	0	25																																																																																									
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0	1	0	0	12.5																																																																																									
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No.	Control block/data	Description	Related data																																				
(6)	Tuner mode switching AM/FM oscillator divisor OSC_DIV WB	(1) AM/FM/WB oscillator divisor control <table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 10px;"> <thead> <tr> <th style="width: 25%;">WB</th> <th style="width: 25%;">OSC DIV</th> <th style="width: 50%;">Divisor</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">Divide by 2</td> </tr> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">Divide by 3</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">Divide by 1</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">Divide by 1</td> </tr> </tbody> </table> * : WB: Select 1 for weather band reception (2) AM oscillator divisor control <table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 10px;"> <thead> <tr> <th style="width: 25%;">OSD D2</th> <th style="width: 25%;">OSC D1</th> <th style="width: 50%;">Divisor</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">Divide by 10</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">Divide by 8</td> </tr> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">Divide by 6</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">Divide by 4</td> </tr> </tbody> </table> In FM mode, only the WB and OSC DIV bits are valid. In AM mode, this function is set up by combination of the OSC D2, OSC (however, this is fixed at the divide-by-2 setting) D1, WB, and the OSC DIV bits. FM (Japan) : Fixed at the divide-by-3 setting FM (other regions) : Fixed at the divide-by-2 setting WB : Fixed at the divide-by-1 setting (OK if WB = 1) In AM mode, set WB = 0, OSC DIV = 0 for the divide-by-2 setting. The OSC D2 and OSC D1 bits can be set according to end product needs. Example : USA : (1) <divide by 2> × (2) <divide by 10> = divide by 20 SW2 : (1) <divide by 2> × (2) <divide by 4> = divide by 8	WB	OSC DIV	Divisor	0	0	Divide by 2	0	1	Divide by 3	1	0	Divide by 1	1	1	Divide by 1	OSD D2	OSC D1	Divisor	0	0	Divide by 10	1	0	Divide by 8	0	1	Divide by 6	1	1	Divide by 4	P0 to P15 DVS						
WB	OSC DIV	Divisor																																					
0	0	Divide by 2																																					
0	1	Divide by 3																																					
1	0	Divide by 1																																					
1	1	Divide by 1																																					
OSD D2	OSC D1	Divisor																																					
0	0	Divide by 10																																					
1	0	Divide by 8																																					
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(7)	FM IQ mixer phase adjustment DELAY_ADJ0 to DELAY_ADJ1	• FM IQ mixer phase adjustment FM-IQMIX phase_Adjust <table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 10px;"> <thead> <tr> <th style="width: 15%;">DELAY_ADJ2</th> <th style="width: 15%;">DELAY_ADJ1</th> <th style="width: 15%;">DELAY_ADJ0</th> <th style="width: 55%;">Adjustment amount</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">Small</td> </tr> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">↓</td> </tr> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">↓</td> </tr> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">↓</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">↓</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">↓</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">↓</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">Large</td> </tr> </tbody> </table>	DELAY_ADJ2	DELAY_ADJ1	DELAY_ADJ0	Adjustment amount	0	0	0	Small	0	0	1	↓	0	1	0	↓	0	1	1	↓	1	0	0	↓	1	0	1	↓	1	1	0	↓	1	1	1	Large	OSC_DIV
DELAY_ADJ2	DELAY_ADJ1	DELAY_ADJ0	Adjustment amount																																				
0	0	0	Small																																				
0	0	1	↓																																				
0	1	0	↓																																				
0	1	1	↓																																				
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1	0	1	↓																																				
1	1	0	↓																																				
1	1	1	Large																																				

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No.	Control block/data	Description	Related data																
(8)	PLL filter switching mode FMFIL AMFIL	<ul style="list-style-type: none"> Switches the PLL filter <p>PLL filter switching</p> <table border="1" style="margin-left: 20px; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="padding: 2px;">Filter state</th> <th style="padding: 2px;">AM/FM</th> <th style="padding: 2px;">AM filter</th> <th style="padding: 2px;">FM filter</th> </tr> </thead> <tbody> <tr> <td style="padding: 2px;">Normal</td> <td style="padding: 2px;">0</td> <td style="padding: 2px;">OFF</td> <td style="padding: 2px;">ON</td> </tr> <tr> <td style="padding: 2px;"></td> <td style="padding: 2px;">1</td> <td style="padding: 2px;">ON</td> <td style="padding: 2px;">OFF</td> </tr> </tbody> </table> <p>Normal mode (MODE = 0) The filter state is switched in conjunction with the AM/FM bit.</p> <p>FM mode (AM/FM = 0) A filter is formed on pins 8 and 11. Since this filter can be independent of the filter used in AM mode, PLL locking can be fast.</p> <p>AM mode (AM/FM = 1) A filter is formed on pins 9 and 10 and with the two internal switches SW1 and SW2. An additional filter is added to pin 5 using an internal resistor and an external capacitor.</p> <div style="text-align: center; margin-top: 20px;"> </div>	Filter state	AM/FM	AM filter	FM filter	Normal	0	OFF	ON		1	ON	OFF	AM/FM				
Filter state	AM/FM	AM filter	FM filter																
Normal	0	OFF	ON																
	1	ON	OFF																
(9)	IC internal signals I/O ports Control data	<ul style="list-style-type: none"> Specifies the I/O direction for the I/O ports <p>Data = 0 : Input port. The value 0 should be specified in normal operation. = 1 : Output port. A value of 1 is used for IC testing.</p> <p>* : This data must be set to 0 at all times other than IC evaluation. Normally set to 0.</p>																	
(10)	Crystal oscillator oscillation frequency fine adjustment data X_SW_0 to X_SW_2	<ul style="list-style-type: none"> Adjusts the crystal 4.5 MHz reference frequency if beating occurs <p>X'tal OSC ADJ [When a 4.5MHz oscillator element is used]</p> <table border="1" style="margin-left: 20px; border-collapse: collapse; text-align: center;"> <tbody> <tr><td style="padding: 2px;">0 0 0</td><td style="padding: 2px;">High (+100Hz)</td></tr> <tr><td style="padding: 2px;">0 0 1</td><td style="padding: 2px;">↓</td></tr> <tr><td style="padding: 2px;">0 1 0</td><td style="padding: 2px;">↓</td></tr> <tr><td style="padding: 2px;">0 1 1</td><td style="padding: 2px;">4.5MHz (Center value)</td></tr> <tr><td style="padding: 2px;">1 0 0</td><td style="padding: 2px;">↓</td></tr> <tr><td style="padding: 2px;">1 0 1</td><td style="padding: 2px;">↓</td></tr> <tr><td style="padding: 2px;">1 1 0</td><td style="padding: 2px;">↓</td></tr> <tr><td style="padding: 2px;">1 1 1</td><td style="padding: 2px;">Low (-100Hz)</td></tr> </tbody> </table>	0 0 0	High (+100Hz)	0 0 1	↓	0 1 0	↓	0 1 1	4.5MHz (Center value)	1 0 0	↓	1 0 1	↓	1 1 0	↓	1 1 1	Low (-100Hz)	R0 to R3, XLVL0 to XLVL2
0 0 0	High (+100Hz)																		
0 0 1	↓																		
0 1 0	↓																		
0 1 1	4.5MHz (Center value)																		
1 0 0	↓																		
1 0 1	↓																		
1 1 0	↓																		
1 1 1	Low (-100Hz)																		

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Continued from preceding page.

No.	Control block/data	Description	Related data																				
(11)	Crystal oscillator oscillation level adjustment data XLVL0 to XLVL2	<ul style="list-style-type: none"> Data used to adjust the crystal 4.5MHz oscillation level when the S/N condition is worsening. <p>X'tal OSC oscillation level adjustment</p> <table border="1" style="display: inline-table; border-collapse: collapse;"> <tr><td style="padding: 2px;">0 0 0</td><td style="padding: 2px;">Low</td></tr> <tr><td style="padding: 2px;">0 0 1</td><td style="padding: 2px;">↓</td></tr> <tr><td style="padding: 2px;">0 1 0</td><td style="padding: 2px;">↓</td></tr> <tr><td style="padding: 2px;">0 1 1</td><td style="padding: 2px;">↓</td></tr> <tr><td style="padding: 2px;">1 0 0</td><td style="padding: 2px;">↓</td></tr> <tr><td style="padding: 2px;">1 0 1</td><td style="padding: 2px;">↓</td></tr> <tr><td style="padding: 2px;">1 1 0</td><td style="padding: 2px;">↓</td></tr> <tr><td style="padding: 2px;">1 1 1</td><td style="padding: 2px;">High</td></tr> </table>	0 0 0	Low	0 0 1	↓	0 1 0	↓	0 1 1	↓	1 0 0	↓	1 0 1	↓	1 1 0	↓	1 1 1	High	R0 to R3, X_SW_0 to X_SW_2				
0 0 0	Low																						
0 0 1	↓																						
0 1 0	↓																						
0 1 1	↓																						
1 0 0	↓																						
1 0 1	↓																						
1 1 0	↓																						
1 1 1	High																						
(12)	Crystal oscillator ACL circuit ON/OFF switching ALC_OFF	<ul style="list-style-type: none"> Switches on and off the ALC (Auto level control) in the crystal oscillation circuit. Normally set to high. <p style="text-align: center;">ALC_ON/OFF switching</p> <table border="1" style="display: inline-table; border-collapse: collapse;"> <tr><td style="padding: 2px; width: 20px;">0</td><td style="padding: 2px;">ALC_OFF</td></tr> <tr><td style="padding: 2px;">1</td><td style="padding: 2px;">Normal operation (ALC_ON)</td></tr> </table>	0	ALC_OFF	1	Normal operation (ALC_ON)																	
0	ALC_OFF																						
1	Normal operation (ALC_ON)																						
(13)	DO pin control data ULD	<ul style="list-style-type: none"> Determines the DO pin output. <p>DO pin control data</p> <table border="1" style="display: inline-table; border-collapse: collapse;"> <tr><th style="width: 20px;">ULD</th><th style="width: 100px;">DO pin</th></tr> <tr><td style="text-align: center;">0</td><td style="text-align: center;">Low when not locked.</td></tr> <tr><td style="text-align: center;">1</td><td style="text-align: center;">Open</td></tr> </table> <p>* In such a case that the DO pin is multiplexed with EEPROM, transmit a setting data that opens the LV25450PNW DO pin control just before reading out the EEPROM data. The following item (14) must also be set when monitoring the unlock detection signal.</p>	ULD	DO pin	0	Low when not locked.	1	Open	UL0, UL1														
ULD	DO pin																						
0	Low when not locked.																						
1	Open																						
(14)	Unlock state detection data UL0, UL1	<ul style="list-style-type: none"> Selects the phase error (ϕE) detection width used to judge the PLL locked state. If a phase error in excess of the ϕE detection width from the table below occurs, the PLL is seen as being in the unlocked state. <p>When the PLL is seen as being unlocked, the detection pin (DO) is set low.</p> <table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th style="width: 20px;">UL1</th> <th style="width: 20px;">UL0</th> <th style="width: 100px;">ϕE detection width</th> <th style="width: 100px;">Detection pin output</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">Stopped</td> <td style="text-align: center;">Open</td> </tr> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">ϕE is output directly</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">$\pm 0.5\mu s$</td> <td style="text-align: center;">ϕE is delayed by 1 to 2 ms.</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">$\pm 1\mu s$</td> <td style="text-align: center;">ϕE is delayed by 1 to 2 ms.</td> </tr> </tbody> </table> <div style="margin-top: 10px;"> </div>	UL1	UL0	ϕE detection width	Detection pin output	0	0	Stopped	Open	0	1	0	ϕE is output directly	1	0	$\pm 0.5\mu s$	ϕE is delayed by 1 to 2 ms.	1	1	$\pm 1\mu s$	ϕE is delayed by 1 to 2 ms.	ULD
UL1	UL0	ϕE detection width	Detection pin output																				
0	0	Stopped	Open																				
0	1	0	ϕE is output directly																				
1	0	$\pm 0.5\mu s$	ϕE is delayed by 1 to 2 ms.																				
1	1	$\pm 1\mu s$	ϕE is delayed by 1 to 2 ms.																				
(15)	Crystal oscillator buffer output stop switching TWO_DOFF	<ul style="list-style-type: none"> Stops the crystal oscillator buffer output. <p>1 bit Crystal oscillator buffer switching</p> <table border="1" style="display: inline-table; border-collapse: collapse;"> <tr><td style="padding: 2px; width: 20px;">0</td><td style="padding: 2px;">Normal operation</td></tr> <tr><td style="padding: 2px;">1</td><td style="padding: 2px;">Stopped</td></tr> </table>	0	Normal operation	1	Stopped																	
0	Normal operation																						
1	Stopped																						
(16)	Phase comparator control data DZ0, DZ1	<ul style="list-style-type: none"> Controls the phase comparator's dead zone. <table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th style="width: 20px;">DZ1</th> <th style="width: 20px;">DZ0</th> <th style="width: 100px;">Dead zone mode</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">DZA</td> </tr> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">DZB</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">DZC</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">DZD</td> </tr> </tbody> </table> <p>The DZA setting is selected after the power-on reset.</p>	DZ1	DZ0	Dead zone mode	0	0	DZA	0	1	DZB	1	0	DZC	1	1	DZD						
DZ1	DZ0	Dead zone mode																					
0	0	DZA																					
0	1	DZB																					
1	0	DZC																					
1	1	DZD																					

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No.	Control block/data	Description	Related data								
(17)	Charge pump control data DLC	<ul style="list-style-type: none"> Forcibly sets the charge pump output to the low level (V_{SS} level). DLC = 1 : Low level DLC = 0 : Normal operation * : If the IC deadlocks with VCO oscillator stopped with the VCO control voltage (V_{tune}) at 0 V, the deadlock can be resolved by setting the charge pump output to the low level and setting V_{tune} to V_{CC}. This item is set to the normal operation state after the power-on reset. 									
(18)	IC internal signal I/O port control data TEST0, TEST1, TEST2	<ul style="list-style-type: none"> Specifies the I/O direction for the I/O ports Data = 0 : Input port. The value 0 should be specified in normal operation. = 1 : Output port. A value of 1 is used for IC testing. * : This data must be set to 0 at all times other than IC evaluation. 									
(19)	RF tuning D/A converter output RFDAC0 to RFDAC8	<ul style="list-style-type: none"> Applies a control voltage to the RF tuning circuit (varactor). 9 bit 	DAC9_SW2, DAC9_SW								
(20)	Tuner off setting TUNEROFF	<ul style="list-style-type: none"> Set the IC to tuner off mode. 1 bit Tuner OFF mode <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">0</td> <td>Normal operation</td> </tr> <tr> <td style="text-align: center;">1</td> <td>Tuner-OFF</td> </tr> </table>	0	Normal operation	1	Tuner-OFF					
0	Normal operation										
1	Tuner-OFF										
(21)	Antenna tuning D/A converter output ANTDAC0 to ANTDAC8	<ul style="list-style-type: none"> Applies a control voltage to the antenna tuning circuit (varactor). 9 bit 	DAC9_SW2, DAC9_SW								
(22)	2.7V REG ADJ REG_ADJ0 REG_ADJ1	<ul style="list-style-type: none"> Adjusts the 2.7 V regulator 2.7V REG ADJ <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">0 0</td> <td>-23mV</td> </tr> <tr> <td style="text-align: center;">0 1</td> <td>(Center value)</td> </tr> <tr> <td style="text-align: center;">1 0</td> <td>+23mV</td> </tr> <tr> <td style="text-align: center;">1 1</td> <td>+64mV</td> </tr> </table>	0 0	-23mV	0 1	(Center value)	1 0	+23mV	1 1	+64mV	
0 0	-23mV										
0 1	(Center value)										
1 0	+23mV										
1 1	+64mV										
(23)	RF block tuning circuit temperature characteristics compensation slope switching data DAC9_SW2 DAC9_SW	<ul style="list-style-type: none"> RF block tuning circuit temperature characteristics compensation slope switching bits 9bit temperature characteristics compensation slope switching <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">0 0</td> <td rowspan="4" style="vertical-align: middle;">Standard (Gradual)</td> </tr> <tr> <td style="text-align: center;">0 1</td> </tr> <tr> <td style="text-align: center;">1 0</td> </tr> <tr> <td style="text-align: center;">1 1</td> </tr> </table>	0 0	Standard (Gradual)	0 1	1 0	1 1	RFDAC0 to RFDAC8, ANTDAC0 to ANTDAC8			
0 0	Standard (Gradual)										
0 1											
1 0											
1 1											
(24)	IQ mixer gain adjustment data IQMIX_GAIN	<ul style="list-style-type: none"> Data used to switch FM IQ mixer gain. 1 bit IQ mixer gain adjustment <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">0</td> <td>Gain Down (with RF-Amp)</td> </tr> <tr> <td style="text-align: center;">1</td> <td>Gain Up (without RF-Amp)</td> </tr> </table>	0	Gain Down (with RF-Amp)	1	Gain Up (without RF-Amp)					
0	Gain Down (with RF-Amp)										
1	Gain Up (without RF-Amp)										
(25)	IQ mixer phase switching data IQ_SW	<ul style="list-style-type: none"> Data used to switch FM IQ mixer phase. 1 bit IQ mixer phase switching <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">0</td> <td>Lower</td> </tr> <tr> <td style="text-align: center;">1</td> <td>Upper</td> </tr> </table>	0	Lower	1	Upper					
0	Lower										
1	Upper										
(26)	Forced AGC (AM/FM) switching data FMAGC_ON AMAGC_ON	<ul style="list-style-type: none"> Data used to operate the forced AGC circuit (antenna dumping). FMAGC_ON : FM AGC [0] = NORMAL, [1] = ON AMAGC_ON : AM AGC [0] = NORMAL, [1] = ON Each 1 bit 									

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No.	Control block/data	Description	Related data																																																												
(27)	IF AGC amplifier circuit off switching NARROW_OFF	<ul style="list-style-type: none"> Switches off the IF AGC amplifier circuit. 1 bit IF AGC amplifier <div style="display: flex; align-items: center; margin-left: 20px;"> <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">0</div> ON (normal operation) <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">1</div> OFF </div>																																																													
(28)	AM/FM wide AGC setting W_AGC0 to W_AGC3	<ul style="list-style-type: none"> Sets the AM/FM wide AGC sensitivity. 4 bit	AM/FM																																																												
(29)	AM/FM narrow AGC setting N_AGC0 to N_AGC3	<ul style="list-style-type: none"> Sets the AM/FM narrow AGC sensitivity. 4 bit	AM/FM																																																												
(30)	AM RF AGC amplifier threshold (steep) and Keyed AGC setting data KEY_AGC0 to KEY_AGC3	<ul style="list-style-type: none"> Sets the AM RF AGC amplifier circuit threshold (steep) and the FM Keyed AGC sensitivity. 4 bit AM-RF-AGC FM-Keyed Amp threshold (steep) AGC threshold <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <table style="border-collapse: collapse;"> <tr><td style="border: 1px solid black; padding: 2px;">0 0 0 0</td><td style="text-align: center;">1.0V</td><td style="text-align: center;">0.14V</td></tr> <tr><td style="border: 1px solid black; padding: 2px;">0 0 0 1</td><td style="text-align: center;">↓</td><td style="text-align: center;">↓</td></tr> <tr><td style="border: 1px solid black; padding: 2px;">0 0 1 0</td><td style="text-align: center;">↓</td><td style="text-align: center;">↓</td></tr> <tr><td style="border: 1px solid black; padding: 2px;">0 0 1 1</td><td style="text-align: center;">↓</td><td style="text-align: center;">↓</td></tr> <tr><td style="border: 1px solid black; padding: 2px;">0 1 0 0</td><td style="text-align: center;">↓</td><td style="text-align: center;">↓</td></tr> <tr><td style="border: 1px solid black; padding: 2px;">.</td><td style="text-align: center;">↓</td><td style="text-align: center;">↓</td></tr> <tr><td style="border: 1px solid black; padding: 2px;">.</td><td style="text-align: center;">↓</td><td style="text-align: center;">↓</td></tr> <tr><td style="border: 1px solid black; padding: 2px;">1 0 1 1</td><td style="text-align: center;">↓</td><td style="text-align: center;">↓</td></tr> <tr><td style="border: 1px solid black; padding: 2px;">1 1 0 0</td><td style="text-align: center;">↓</td><td style="text-align: center;">↓</td></tr> <tr><td style="border: 1px solid black; padding: 2px;">1 1 0 1</td><td style="text-align: center;">↓</td><td style="text-align: center;">↓</td></tr> <tr><td style="border: 1px solid black; padding: 2px;">1 1 1 0</td><td style="text-align: center;">↓</td><td style="text-align: center;">↓</td></tr> <tr><td style="border: 1px solid black; padding: 2px;">1 1 1 1</td><td style="text-align: center;">2.5V</td><td style="text-align: center;">2.2V</td></tr> </table> </div>	0 0 0 0	1.0V	0.14V	0 0 0 1	↓	↓	0 0 1 0	↓	↓	0 0 1 1	↓	↓	0 1 0 0	↓	↓	.	↓	↓	.	↓	↓	1 0 1 1	↓	↓	1 1 0 0	↓	↓	1 1 0 1	↓	↓	1 1 1 0	↓	↓	1 1 1 1	2.5V	2.2V	AM/FM																								
0 0 0 0	1.0V	0.14V																																																													
0 0 0 1	↓	↓																																																													
0 0 1 0	↓	↓																																																													
0 0 1 1	↓	↓																																																													
0 1 0 0	↓	↓																																																													
.	↓	↓																																																													
.	↓	↓																																																													
1 0 1 1	↓	↓																																																													
1 1 0 0	↓	↓																																																													
1 1 0 1	↓	↓																																																													
1 1 1 0	↓	↓																																																													
1 1 1 1	2.5V	2.2V																																																													
(31)	AM RF AGC amplifier threshold (gradual) and All Pass Filter setting data APF_ADJ0 to APF_ADJ3	<ul style="list-style-type: none"> Data used to set the AM RF AGC amplifier threshold (gradual) and the All Pass Filter. 4 bit AM-RF-AGC FM-Keyed AGC threshold phase shift Amp threshold the software trimming (gradual) <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <table style="border-collapse: collapse;"> <tr><td style="border: 1px solid black; padding: 2px;">0 0 0 0</td><td style="text-align: center;">1.0+VBE</td><td style="border: 1px solid black; padding: 2px;">0 0 0 0</td><td style="text-align: center;">0</td><td style="text-align: center;">Small</td></tr> <tr><td style="border: 1px solid black; padding: 2px;">0 0 0 1</td><td style="text-align: center;">↓</td><td style="border: 1px solid black; padding: 2px;">1 0 0 0</td><td style="text-align: center;">1</td><td style="text-align: center;">↓</td></tr> <tr><td style="border: 1px solid black; padding: 2px;">0 0 1 0</td><td style="text-align: center;">↓</td><td style="border: 1px solid black; padding: 2px;">0 1 0 0</td><td style="text-align: center;">2</td><td style="text-align: center;">↓</td></tr> <tr><td style="border: 1px solid black; padding: 2px;">0 0 1 1</td><td style="text-align: center;">↓</td><td style="border: 1px solid black; padding: 2px;">1 1 0 0</td><td style="text-align: center;">3</td><td style="text-align: center;">↓</td></tr> <tr><td style="border: 1px solid black; padding: 2px;">0 1 0 0</td><td style="text-align: center;">↓</td><td style="border: 1px solid black; padding: 2px;">0 0 1 0</td><td style="text-align: center;">4</td><td style="text-align: center;">↓</td></tr> <tr><td style="border: 1px solid black; padding: 2px;">.</td><td style="text-align: center;">↓</td><td style="border: 1px solid black; padding: 2px;">.</td><td style="text-align: center;">.</td><td style="text-align: center;">↓</td></tr> <tr><td style="border: 1px solid black; padding: 2px;">.</td><td style="text-align: center;">↓</td><td style="border: 1px solid black; padding: 2px;">.</td><td style="text-align: center;">.</td><td style="text-align: center;">↓</td></tr> <tr><td style="border: 1px solid black; padding: 2px;">1 0 1 1</td><td style="text-align: center;">↓</td><td style="border: 1px solid black; padding: 2px;">1 1 0 1</td><td style="text-align: center;">11</td><td style="text-align: center;">↓</td></tr> <tr><td style="border: 1px solid black; padding: 2px;">1 1 0 0</td><td style="text-align: center;">↓</td><td style="border: 1px solid black; padding: 2px;">0 0 1 1</td><td style="text-align: center;">12</td><td style="text-align: center;">↓</td></tr> <tr><td style="border: 1px solid black; padding: 2px;">1 1 0 1</td><td style="text-align: center;">↓</td><td style="border: 1px solid black; padding: 2px;">1 0 1 1</td><td style="text-align: center;">13</td><td style="text-align: center;">↓</td></tr> <tr><td style="border: 1px solid black; padding: 2px;">1 1 1 0</td><td style="text-align: center;">↓</td><td style="border: 1px solid black; padding: 2px;">0 1 1 1</td><td style="text-align: center;">14</td><td style="text-align: center;">↓</td></tr> <tr><td style="border: 1px solid black; padding: 2px;">1 1 1 1</td><td style="text-align: center;">2.5V+VBE</td><td style="border: 1px solid black; padding: 2px;">1 1 1 1</td><td style="text-align: center;">15</td><td style="text-align: center;">Large</td></tr> </table> </div>	0 0 0 0	1.0+VBE	0 0 0 0	0	Small	0 0 0 1	↓	1 0 0 0	1	↓	0 0 1 0	↓	0 1 0 0	2	↓	0 0 1 1	↓	1 1 0 0	3	↓	0 1 0 0	↓	0 0 1 0	4	↓	.	↓	.	.	↓	.	↓	.	.	↓	1 0 1 1	↓	1 1 0 1	11	↓	1 1 0 0	↓	0 0 1 1	12	↓	1 1 0 1	↓	1 0 1 1	13	↓	1 1 1 0	↓	0 1 1 1	14	↓	1 1 1 1	2.5V+VBE	1 1 1 1	15	Large	AM/FM
0 0 0 0	1.0+VBE	0 0 0 0	0	Small																																																											
0 0 0 1	↓	1 0 0 0	1	↓																																																											
0 0 1 0	↓	0 1 0 0	2	↓																																																											
0 0 1 1	↓	1 1 0 0	3	↓																																																											
0 1 0 0	↓	0 0 1 0	4	↓																																																											
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.	↓	.	.	↓																																																											
1 0 1 1	↓	1 1 0 1	11	↓																																																											
1 1 0 0	↓	0 0 1 1	12	↓																																																											
1 1 0 1	↓	1 0 1 1	13	↓																																																											
1 1 1 0	↓	0 1 1 1	14	↓																																																											
1 1 1 1	2.5V+VBE	1 1 1 1	15	Large																																																											
(32)	S-meter shifter control S_METER0 to S_METER4	<ul style="list-style-type: none"> Controls the FM S-meter shifter circuit output value. 5 bit																																																													
(33)	Analog (narrow) IF AGC clamp variations correction ADJ_N0 to ADJ_N2	<ul style="list-style-type: none"> Corrects the sample-to-sample variations in the IF AGC clamp circuit. Amount of correction : ±2 dB 3 bit																																																													
(34)	FM PIN diode forced on state bit FMFETOFF	<ul style="list-style-type: none"> Forcibly sets the FM PIN diode to the on state. 1 bit																																																													

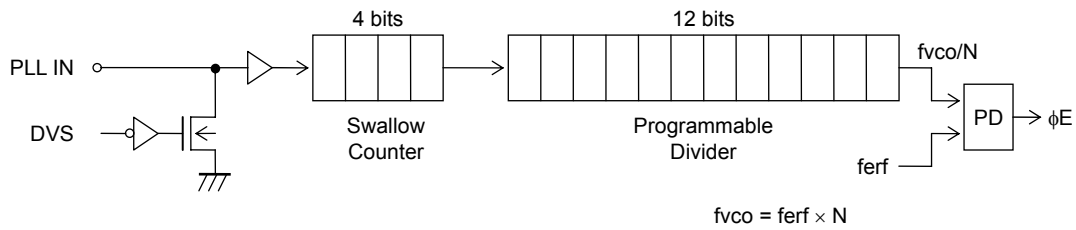
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No.	Control block/data	Description	Related data
(35)	LSI test data W_KEYED	<ul style="list-style-type: none"> Modifies the keyed AGC connection circuit. 1 bit Keyed AGC switch <div style="display: inline-block; border: 1px solid black; padding: 2px; margin: 5px;"> 0 Wide + narroww 1 Narrow only </div>	
(36)	Sub-Address	<ul style="list-style-type: none"> Sub-code address Each 1 bit	
(37)	OFFSET_SW	<ul style="list-style-type: none"> The DC offset was given to the differential motion part of LO-OSC for the IRR improvement, and the function to correct Duty was added. It is control Bit to stop this function, and to switch in a state past (The offset giving is not done). 1BITbit	

Programmable Divider Structure



DVS	Set divisor (N)	Input frequency range (f (MHz))	IC internal PLL IN pin
1	272 to 65535	$120 \leq f \leq 270$	Selected
0	-	-	Stopped

* : Since the IC is closed internally, the input sensitivity is not specified.

Phase Comparator and Charge Pump Circuits

(1) Phase comparator and charge pump operation

In the PLL circuit block shown in figure 1, the phase comparator compares the phases of the reference frequency (f_r) and the comparison frequency (f_p), and outputs the amount of the phase difference from the charge pump.

Figure 1 PLL Circuit Block

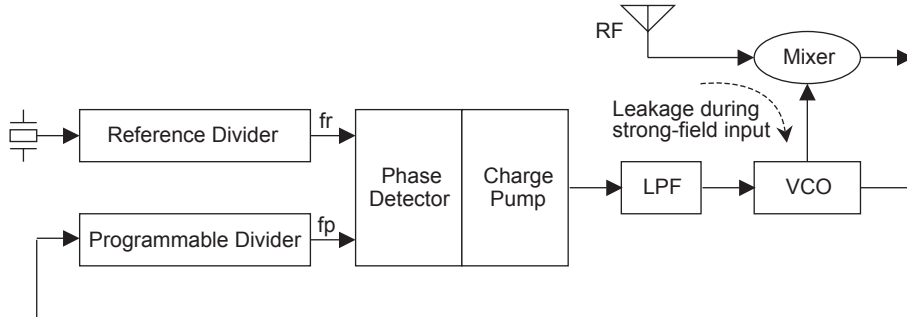
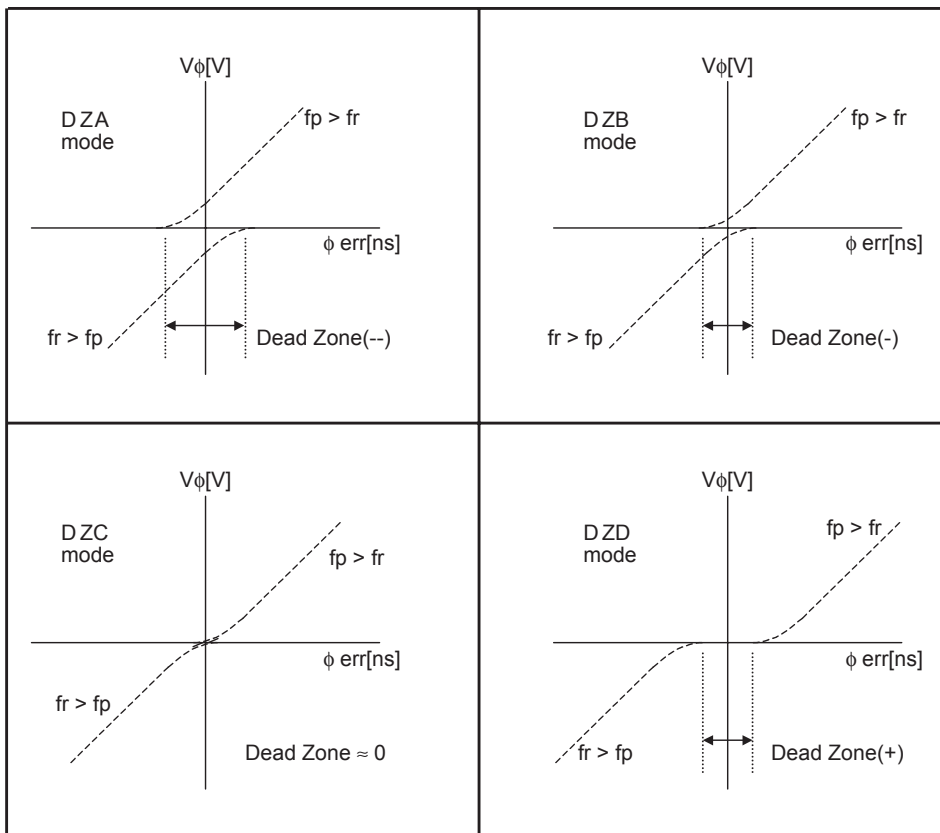


Figure 2 shows the phase comparator/charge pump output characteristics. The phase comparator outputs a voltage V_ϕ that is proportional to the phase difference ϕ between f_r and f_p . The phase comparator's characteristics can be switched by changing the phase comparator dead zone mode setting. The phase comparator can be set to modes (DZA, DZB) in which both the charge pump p-channel and n-channel sides are turned on when the phase difference is small, or can be set to a mode (DZD) that does not output the phase difference when the phase difference is small.

Figure 2 Phase Comparator/Charge Pump Characteristics



(2) Dead zone mode characteristics and selection criteria

This section describes the characteristics of each dead zone mode and the criteria for selecting that mode.

(1) DZA mode

In DZA mode, the correction signal is output from the charge pump even if the reference frequency (fr) and comparison frequency (fp) match. This results in excellent signal-to-noise ratio characteristics. However, due to the generation of reference frequency component sidebands, beating may occur in the presence of a strong input signal. This is because the PLL loop responds sensitively to leakage components from the RF stage through the mixer and this modulates the VCO.

(2) DZB mode

Like DZA mode, in DZB mode the correction signal is output from the charge pump even if the reference frequency (fr) and comparison frequency (fp) match. However, the correction signal voltage is lower in DZB mode than in DZA mode. The feature of this mode is that it provides a better signal-to-noise ratio than DZC or DZD mode yet is less susceptible to beating than DZA mode.

(3) DZC mode

In DZC mode, a correction signal proportional to the phase difference between the reference frequency (fr) and comparison frequency (fp) is output from the charge pump. A small amount of noise may occur when the phase difference is close to 0 ns. Since the signal-to-noise ratio may degrade significantly at low temperatures (under -30°C), this mode should not be used.

(4) DZD mode

In DZD mode, a correction signal proportional to the phase difference between the reference frequency (fr) and comparison frequency (fp) is output from the charge pump. The correction signal is not output when the phase difference is in the vicinity of $\pm <a \text{ few ns}>$. As a result the signal-to-noise ratio is worse than the other modes, but the occurrence of beating is suppressed.

Power supply turning on/cutting timing and power-on reset

Recommended operating conditions/Ta=25°C, GND=0V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Operation power-supply voltage	Vcop_H	PIN 3,27,35,54,55,61	7.5		8.5	V
	Vcop_L	PIN 16,25,41	4.5		5.5	V
Internal logic voltage	VREG3	PIN 26	2.7		3.3	V
	VREG4	PIN 15	3.7		4.3	V
Power supply turning on time(8.0V → 5.0V)	T7		10		100	ms
Internal register maintenance voltage	Vhmin3	PIN 26 *1	VREG3		2.2	V
	Vhmin4	PIN 15 *1	VREG4		2.2	V
Internal register reset voltage	Voff	PIN 16,25,41 *1	0		0.2	V
Internal register reset power supply start-up time	tPOR	PIN 16,25,41 *1	0.05		3	ms
Power supply turning on time(5.0V → 8.0V)	T14		10		100	ms

*1: Design reference value

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