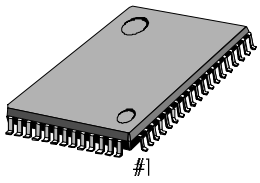
KA8510 1CHIP ANALOG CORDLESS TRANSCEIVER

INTRODUCTION

KA8510 is a monolithic circuit which can be used for high performance 46/49MHz MCA type Cordless Phone System. It is a transceiver IC for FM/FSK transmitting/receiving system, and is a complete one chip FM/FSK transceiver IC of 46/49MHz which includes transmitting and receiving functions for FM/FSK, a COMPANDOR to remove external noise, and PLL (Phase Locked Loop) of channel selection function which blocks surrounding frequency interference.
It has wide range of applications to FM/FSK transmitting/receiving of VHF bandwidth, including the cordless phone, and narrow band voice and data transmitting/receiving system. To make applications easy and simple, peripheral parts were minimized.

64-QFP-1420C



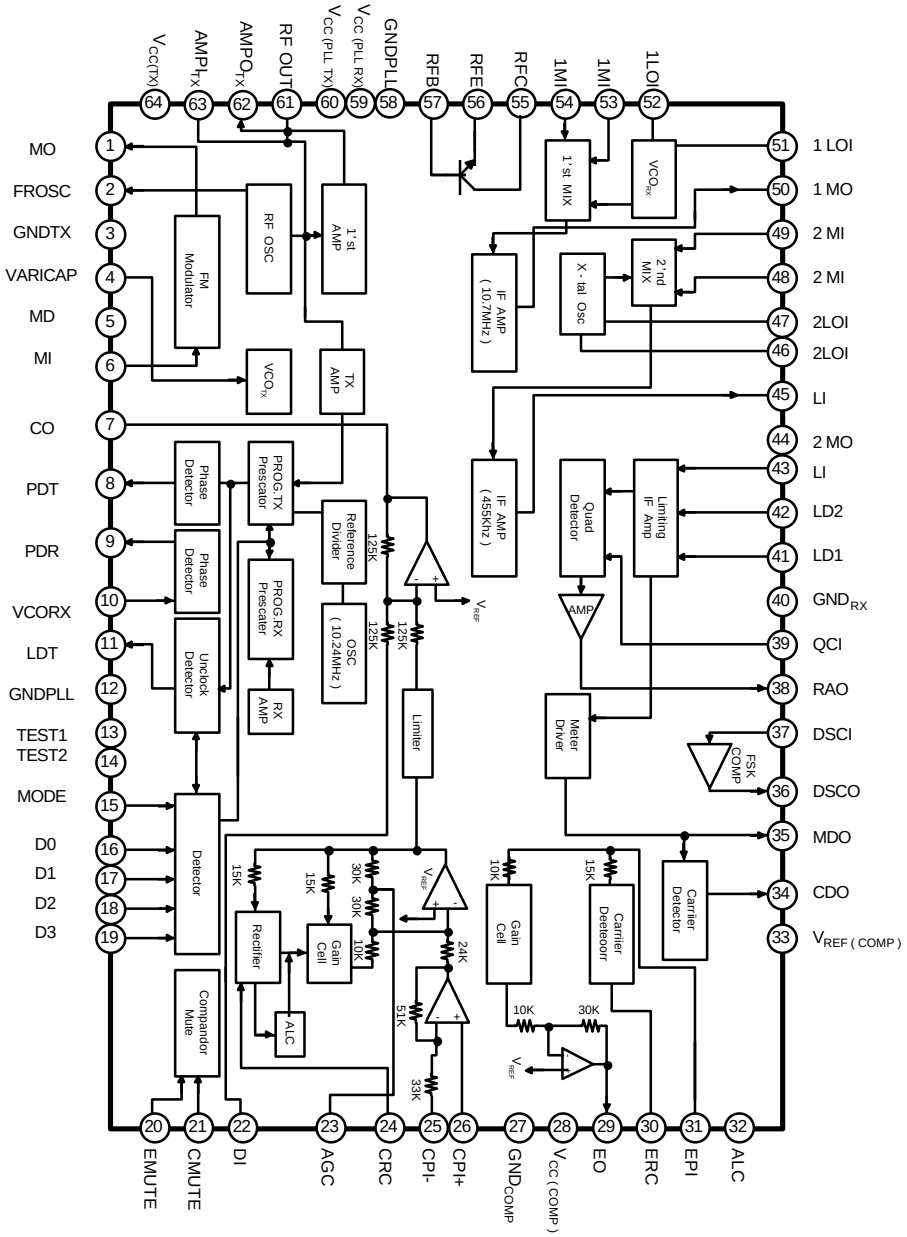
ORDERING INFORMATION

Device	Package	Operating Temperature
KA8510Q	64-QFP-1420C	-25°C ~ + 75°C

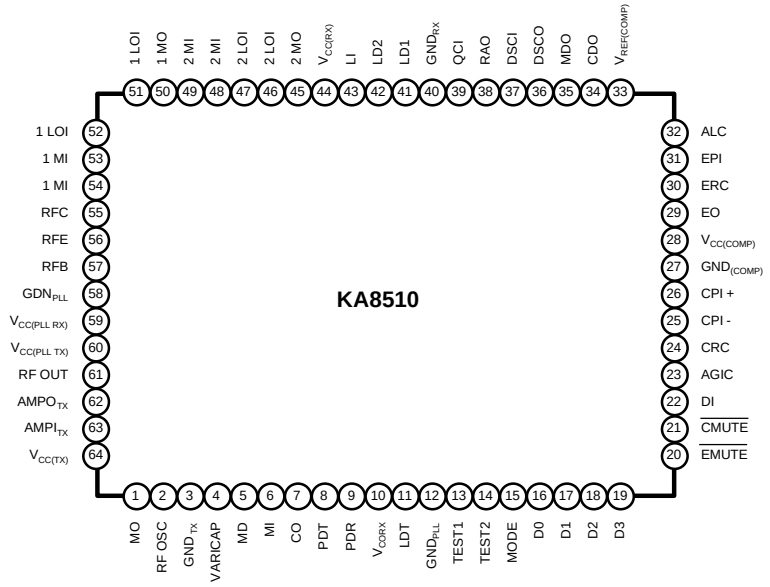
FEATURES

- Operating voltage range : 2 ~ 6V
- Typical supply current : 20mA at 3V
- Built-in dual conversion receiver, transmitter, compandor and PLL
- Compandor part
  - Easy gain control to use external component
  - Included ALC (automatic level control) circuit
  - Mute logic, Data amp
- FM Transmitter part
  - Included variable capacitance
  - Adjustable power amp gain
- FM Receiver part
  - Complete dual conversion circuit with RF amplifier
  - Excellent input sensitivity (0.7μVrms at 12dB SINAD)
- PLL part
  - 10/15 channels selectable (both transmitter/receiver)
  - Include oscillation circuit with external crystal (10.24MHz)
  - Unlock detector (Phase difference more than 6.25μs)

BLOCK DIAGRAM



PIN CONFIGURATION



PIN DESCRIPTION

Pin No	Symbol	Description
1	MO	It Generates carrier signal and modulates frequency. The audio signal enters the MI terminal and causes the internal reactance to vary, which changes the frequency generated from the coil tank, resulting in frequency modulation.
2	RF OSC	Input terminal of RF carrier signal. By varying the capacitor value, which is connected between MO terminals, the amount of frequency modulation (Hz/mV) can be adjusted. Larger capacitor value increases the amount of modulation.
3	GND_{TX}	Ground. Ground of a transmitter part.
4	VARICAP	Variable capacitor included in the chip. Since the RF oscillation frequency changes according as the detected pulse error at PLL influences the variable capacitor, it becomes useful when a channel is being changed.
5	MD	AC bypass terminal of FM modulator. A capacitor is connected between this terminal and GND.
6	MI	Input terminal of RF modulator. It inputs an audio signal through the compressor of compandor to modulate FM. Variation of RF generated frequency per voltage (mV) at this terminal becomes the sensitivity of frequency modulation.

Pin No	Symbol	Description
7	CO	It is a COMPRESSOR output terminal of COMPANDOR, and is connected to the modulation input terminal of transmitter.
8	PDT	It is a phase detector output terminal of transmitter at PLL. If $f_{TX} > f_{REF}$ or f_{TX} is leading -> output is negative pulse. If $f_{TX} < f_{REF}$ or f_{TX} is lagging -> output is positive pulse. If $f_{TX} = f_{REF}$ and the same phase -> output is high impedance.
9	PDR	It is a phase detector output terminal of transmitter at PLL. If $f_{RX} > f_{REF}$ or f_{RX} is leading -> output is negative pulse. If $f_{RX} < f_{REF}$ or f_{RX} is lagging -> output is positive pulse. If $f_{RX} = f_{REF}$ and the same phase -> output is high impedance.
10	VCO_{RX}	This is a variable capacitor terminal, and is included in the chip. It is used as an input terminal where 1'st local oscillation frequency is oscillates. The internal variable capacitor has the value of 10~25pF according to the applied voltage ($0.7 \sim V_{CC}$)
11	LDT	It is an output terminal of lock detector of transmitter stage at PLL. Output is low if PLL is in lock state, and is high if PLL is in unlock state.
12	GND_{PLL}	Ground It is used as ground of logic section at PLL.
13	TEST1	This terminal tests operation of PLL. It is operated together with test2. When it is not in use, a resistor is connected between V_{CC} and this terminal.
14	TEST2	It is an input terminal for PLL test. When test is set to high, outputs of Rx-programmable divider and Tx-programmable divider can be tested at LDT terminal.
15	MODE	It is PLL's mode selection terminal. This terminal is set to high if it is used for the base set of a cordless phone, and is set to low if it is used for the hand set of a cordless phone.
16 17 18 19	D0 D1 D2 D3	It is a decode input terminal for PLL's channel selection. Four bit binary code of D0(LSB) ~ D3(MSB) are given by MICOM. These inputs have internal pull down devices
20	$\overline{\text{E MUTE}}$	It is EXPANDER MUTE terminal of COMPANDOR, and is the final MUTE block of an EXPANDER located next to the receiver terminal. It blocks the data signal of MICOM being transmitted to an user, and is connected to the Rx MUTE terminal of MICOM. Expanding is executed if it is low.

Pin No	Symbol	Description
21	$\overline{\text{C MUTE}}$	It is a COMPRESSOR MUTE terminal of a COMPANDOR. MUTE block is inserted before the data input terminal of COMPRESSOR to avoid duplication of data transmission from MICOM (between the base and hand set) with the voice signal. It is connected to the TX MUTE terminal of MICOM. Compressing is executed if this terminal is high, and COMPRESSOR MUTE is executed if it is low.
22	DI	It is a data input terminal of COMPRESSOR, and is used to transmit data of handset MICOM to baseset, or data of baseset MICOM to handset. This terminal is connected to the data output terminal of MICOM.
23	AGIC	This terminal is used for bypassing an AC element at the feedback loop which comes from the SUM AMP block of COMPRESSOR. A capacitor should be connected between this terminal and GND.
24	CRC	This terminal is used for converting waveform from the full wave rectifier to DC element at the rectifier block of COMPRESSOR. (RC = 22msec)
25	CPI -	It is a PRE AMP inverting input terminal of COMPRESSOR, and is used for adjusting the negative feedback loop gain. (in application, gain is 5)
26	CPI +	It is a PRE AMP non-iverting input terminal of COMPRESSOR, and is used as an input terminal for voice signal.
27	GND_{COMP}	Ground Ground of COMPANDOR
28	$V_{CC(COMP)}$	Supply voltage Power supply terminal of COMPANDOR
29	EO	It is an output terminal of EXPANDER, which a regenerated voice signal comes out.
30	ERC	This terminal is used for inverting waveform from the full wave rectifier to DC element at the rectifier block of EXPANDER. (RC = 22 msec)
31	EPI	It is a SUM AMP input terminal of EXPANDER. After the demodulated signal passed through the 2'nd order low pass filter, the voice signal enters this terminal.

Pin No	Symbol	Description
32	ALC	It is a input reference voltage terminal of ALC (Automatic Level Control). ALC circuit may be turned off according to the ALC reference voltage, or magnitude of output voltage may be limited if it is higher than a certain level. It is used for adjusting THD of output voltage of COMPRESSOR to less than 3% or to limit the frequency deviation of TX in case the input is higher than a certain level.
33	$V_{REF(COMP)}$	It is a voltage reference (V_{REF} = 1V) used for supplying a constant voltage to the COMPRESSOR and EXPANDER of COMPANDOR.
34	CDO	It is an output terminal of a carrier detector, and outputs the contents of a buffer of a Meter Driver which is turned on/off according to a certain signal level detected by the Meter driver. Since this terminal is an open collector output type, it requires a pull-up resistor, and is connected to RSSI terminal of MICOM.
35	MDO	It is an output terminal of a Meter Driver. (RSSI : Received Signal Strength Indicator) Amplitude of RF input signal for useful frequency is detected by a Meter Driver circuit. The Meter Driver circuit has perfect linear characteristic of 60dB range for input signal level. (0.1μA/dB)
36	DSCO	It is an output terminal of Data Slicing Comparator. It separates FSK (Frequency-Shift Keying) Serial data and executes data shaping and limiting.
37	DSCI	It is an input terminal of Data Slicing Comparator, and is a non-inverting type with negative input terminal biased to 1/2 V_{CC}.
38	RAO	It is a recovered audio output terminal. Voice signal which is detected by Quadrature Detector is amplified and then is output via this terminal.
39	QCI	It is a Quadrature Coil input terminal. The 455KHz Oscillator circuit is comprised of L_P = 680μH, C_P = 180pF, LC Tank circuit. Voice signal is detected by mixture of 455KHz (by phase difference) with is converted from second Mixer.
40	GND_{RX}	Ground Ground for receiver

Pin No	Symbol	Description
41	LD1	It is a Limiter input and Decoupling terminal, and is used for removing amplitude modulation element caused by fading or noise of FM signal.
42	LD2	Limiting IF amplifier amplifies and limits second intermediate frequency 455KHz signal.
43	LI	The input impedance of Limiting IF amplifier is designed to 1.5Kohm. While FM wave is transmitted with constant magnitude, its magnitude is slightly modulated due to the reflection from obstacles, fading phenomenon, noise wave, etc., and mixed with AM wave element before it enters the receiver's antenna. The Limiter makes uniform amplitude by removing these AM wave element.
44	$V_{CC(RX)}$	Supply Voltage This terminal is used for supplying power to a receiver.
45	2 MO	It is an output terminal of second mixer. Second intermediate frequency 455KHz, generated by mixing first intermediate frequency (10.7MHz) and second local oscillator, is output.
46 47	2 LOI 2 LOI	It is an input terminal of second local oscillator. It generates second local oscillator frequency to convert output from first Mixer (10.7MHz) to second intermediate frequency. It is an oscillator with crystal of 10.24MHz,10.245 MHz.
48 49	2 MI 2 MI	It is an input terminal of second Mixer. Output from first Mixer is entered to second Mixer input terminal via 10.7MHz ceramic filter. Second Mixer converts frequency to second intermediate frequency (455KHz : AM IF).
50	1 MO	It is an output terminal of first Mixer. Signal from the first Mixer and frequency of first local oscillator are mixed and become first intermediate frequency, which is then output through this terminal. The output terminal is made of emitter follower with an output impedance of 330ohm to match 330ohm input/output impedance of 10.7MHz ceramic filter.
51 52	1 LOI 1 LOI	It is an input terminal of first local oscillator. The local oscillator is a voltage controlled oscillator. Local oscillation frequency and received frequency are mixed at the first Mixer and then are converted to first intermediate frequency of 10.7MHz.

Pin No	Symbol	Description
53 54	1 MI 1 MI	It is an input terminal of first Mixer. This Mixer is made of double balanced multiplier. Received signal (46/49 MHz) amplified at RF AMP is input to this terminal.
55	RFC	It is an collector terminal of RF amplifier transistor. Amount of amplification can be selected using the resistor load at RF amplifier collector.
56	RFE	It is an emitter terminal of RF amplifier transistor. The gain of RF AMP can be adjusted using the resistance of emitter degeneration. I_E = 1.5mA when emitter of RF AMP is connected to the ground, and voltage gain on 1 Kohm of collector load is Av = 20dB
57	RFB	It is a base terminal of RF amplifier transistor. Base of TR is biased internally to about 0.8V from the common-emitter amplifier design. This RF AMP amplifies subtle signal received by the antenna to proper size for conversion into first intermediate frequency (10.7MHz).
58	GND	Ground Ground for analog at PLL.
59	$V_{CC(PLL\ RX)}$	Supply Voltage This terminal supplies power from PLL to Rx ECL area.
60	$V_{CC(PLL\ TX)}$	Supply Voltage This terminal supplies power from PLL to Tx ECL area.
61	RF OUT	This terminal outputs transmission frequency (46/49MHz) from RF oscillator. Tx spurious characterestics can be adjusted by connection a capacitor between pin 63 and this terminal.
62	AMPO TX	This is an output terminal of a POWER AMP, and is open collector type. It provides 2 point oscillation and amplification to narrow the bandwidth of transmitter output.
63	AMPI TX	This terminal controls the gain of a POWER AMP, and is open base type. The AMP gain can be selected by connecting a variable resistor between V_{CC} and this terminal.
64	V_{CC}(TX)	Supply Voltage It is a V_{CC} of transmitter. It permits voltage supply to use seperately if the transmission output is desired.

ABSOLUTE MAXIMUM RATINGS (Ta = 25 C)

Characteristics	Symbol	Value	Unit
Maximum Supply Voltage	V_{CC}	7	V
Power Dissipation	P_D	600	mW
Junction Temperature	T_J	+ 125	°C
Operation Temperature	T_{OPR}	-25 ~ + 75	°C
Storage Temperature	T_{STG}	-65 ~ + 150	°C

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Unit
Operating Voltage	V_{CC}	-	2.0	-	6.0	V
Total Operating Current	I_{CC}	-	-	20	-	mA
RECEIVER (V_{CC} = 5V, f_C = 49.7MHz, f_{DEV} = ± 3KHz, f_{MOD} = 1KHz, Ta = 25°C, Unless otherwise specified)						
Operating Current 1	I_{CC} 1	RFin = 1mVrms V_{CC} = 3V	-	3.5	6.0	mA
Operating Current 2	I_{CC} 2	V_{CC} = 5V, RFin = 1mVrms	-	4.5	7.0	mA
Input for -3dB Sensitivity	V_{LIM}	RFin = 1mVrms → 0dB RFin = 1mVrms → -3dB	-	0.7	2.0	µVrms
Input for 20dB Sensitivity	$V_{I(SEN)}$	Modulation Input None Modulation Input	-	0.7	2.0	µVrms
S/N Ratio	S/N	Modulation Input None Modulation Input	48	55	-	dB
Recoverd Audio Output	$V_{O(RA)}$	RFin = 1mVrms f_{mod} = 1KHz f_{dev} = ± 3KHz	210	350	490	mVrms
Noise Output Level	V_{NO}	RFin = None Input	-	250	400	mVrms
Recoverd Audio Output Voltage Drop	$V_{O(RAD)}$	V_{CC} = 5V → 2V RFin = 1mVrms	-8	-1.5	-	dB
Direct Output Voltage	$V_{O(DET)}$	RFin = 1mVrms	1.6	2.3	3.0	V_{dc}
Carrier Detector Throshold	$V_{TH(DET)}$	RFin = None Input $R_{L(34)}$ = 10KΩ	0.49	0.60	0.73	V_{dc}

ELECTRICAL CHARACTERISTICS (continued)

Characteristics	Symbol	Test Conditions	Min	Typ	Max	Unit
RECEIVER (T_a = 25°C, Unless otherwise specified)						
Comparator Threshold Voltage Difference	$\Delta V_{TH (COMP)}$	$V_{I (COMP)}$ = 1KHz, 150mV_{P-P} $R_{L (37)}$ = 180KΩ	70	110	150	mW
Comparator Output Voltage 1	$V_{OH (COMP)}$	″	3.8	4.25	-	V_{dc}
Comparator Output Voltage 2	$V_{OL (COMP)}$	″	-	0.25	0.5	V_{dc}
Second Mixer Coversion Voltage Gain	$\Delta G_{V (2M)}$	$V_{I (54)}$ = 1mVrms $R_{L (50)}$ = 330Ω	14	18	22	dB
First Mixer Coversion Voltage Gain	$\Delta G_{V (1M)}$	$V_{I (48)}$ = 1mVrms $R_{L (45)}$ = 330 KΩ	17	21	26	dB
AM Rejection Ratio	AMR	RFin = 1mVrms AM MOD = 30%	25	35	-	dB
Detector Output Distortion	THD_{DET}	RFin = 1mVrms	-	2.0	3.0	%
Detector Output Resistance	$R_{O (DET)}$	RFin = 1mVrms	-	1.4	2.0	KΩ
Detector Output DC Voltage Change Ratio	$\Delta V_{O (DET)}$	RFin = 1mVrms	-	0.12	0.2	V/KHz
Meter Drive Slope	MDS	-	70	100	135	nA/dB
First Mixer Input Resistance	$R_{I (1M)}$	f_C = 50MHz	500	690	-	Ω
First Mixer Input Capacitance	$C_{I (1M)}$	f_C = 50MHz	-	7.2	10	pF
Limitter Input Sensitivity	$V_{I (LIM)}$	f_C = 455MHz, 20dB S/N	-	100	250	μVrms
Second Mixer Input Sensitivity	$S_{V (2M)}$	f_C = 10.7MHz, 20dB S/N	-	10	25	μVrms
First Mixer 3rd Order Intercept	3RD	-	-	-2.2	-	μVrms
RF Amp DC Current Gain	$G_{I (AMP)}$	V_{CC} = 5Vdc	1.0	1.5	2.5	μVrms

ELECTRICAL CHARACTERISTICS (continued)

Characteristics	Symbol	Test Conditions	Min	Typ	Max	Unit
TRANSMITTER (V_{CC} = 3V, f_C = 49.86MHz, T_a = 25°C, Unless otherwise specified)						
Operating Current	I_{CC}	V_{CC} = 3V	1.0	1.5	2.0	mA
Modulation Senstitivity	S_{MOD}	V_{in} = 0.9 ~ 1.1V	100	150	200	Hz/mV
Maximum Deviation	$\Delta f_{(MAX)}$	V_{in} = 0 ~ 2.0V	± 40	± 70	± 120	KHz
First Amp bias Voltage	V_{BIAS}	V_{in} = Open	0.5	0.7	0.9	V
First Amp RF Out Voltage	V_{RF}	f_O = 49.860MHz	100	300	-	mVrms
Variable Capacitance	V_{CAP}	Zero Bias	-	30	-	pF
COMPRESSOR (V_{CC}=3V, f=1MHz, Ta = 25°C, Unless otherwise specified)						
Operating Current	I_{CC}	No signal	-	3.6	6.0	mA
Reference Voltage	V_{REF}	No signal	0.9	1.0	1.1	V_{dc}
Standard Output Voltage	$V_{O(COMP)}$	V_{inc} = 13mVrms → 0dB	240	300	340	mVrms
Compressor Gain Difference	$\Delta G_{V1(COMP)}$	V_{inc} = -20dB	-0.5	0	+0.5	dB
	$\Delta G_{V2(COMP)}$	V_{inc} = -40dB	-1.0	0	+1.0	dB
Compressor Output Distortion	THD_{COMP}	V_{inc} = 0dB	-	0.5	1.0	%
Mute Attenuation Ratio	ATT_{MUTE}	V_{inc} = 0dB, $\overline{CMUTE}$ = GND	60	80	-	dB
Compressor Limitting Voltage	$V_{LIM(COMP)}$	V_{inc} = Variable	1.15	1.35	1.50	V_{P-P}
ALC	V_{ALC}	-	280	325	360	mVrms
EXPANDER (V_{CC} = 3V, f = 1MHz, Ta = 25°C, Unless otherwise specified)						
Standard Output Voltage	$V_{O(EXP)}$	V_{ine} = 180mVrms → 0dB	110	130	160	mVrms
Expander Gain Difference	$\Delta G_{V1(EXP)}$	V_{in} = -10dB	-0.5	0	+0.5	dB
	$\Delta G_{V2(EXP)}$	V_{in} = -20dB	-1.0	0	+0.1	dB
	$\Delta G_{V3(EXP)}$	V_{in} = -30dB	-1.5	0	+1.5	dB
Expander Output Distortion	THD_{EXP}	V_{in} = 0dB	-	0.5	1.5	%
Mute Attenuation Ratio	ATT_{MUTE}	V_{in} = 0dB	60	85	-	dB
Expander Maximum Output Voltage	$V_{OEXP(MAX)}$	V_{ine} = Variable THD = 10%	500	600	-	mVrms

ELECTRICAL CHARACTERISTICS (continued)

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Unit
PLL (V_{CC} = 3V, Ta = 25°C, Unless otherwise specified)						
Input Current	I_{IH}	V_{in} = V_{CC} - 0.5V	30	50	80	µA
	I_{IL}	V_{in} = 0V	-	0	1	
Input Voltage	V_{IH}	I_{in} = 20µA	1.2	1.5	1.7	V
	V_{IL}	I_{in} = 3µA	0	0.3	0.5	
Output Voltage	$V_{OH\,1}$	PDT, PDR : I_O = 1mA(sourcing)	2.3	2.7	3.0	V
	$V_{OL\,1}$	PDT, PDR : I_O = 1mA(Sinking)	0	0.3	0.5	
	$V_{OH\,2}$	LDT : I_O = 1mA(sourcing)	2.3	2.7	3.0	V
	$V_{OL\,2}$	LDT : I_O = 1mA(Sinking)	0	0.3	0.5	
Tx Counter	f_{TX}	$f_{in(TX)}$ = 42MHz 300mV_{p-p}	-1	Fout	+1	Hz
Rx Counter	f_{RX}	$f_{in(RX)}$ = 42MHz 300mV_{p-p}	-1	Fout	+1	Hz

APPLICATION CIRCUIT