Operation Description & Block Diagram

TW338/339 Series

1 Document Info

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1.2 Scope

1.3 History

Revision	Author	Issue Date	Comments
1.0	KSCHOW	19-May-04	Initial Revision
2.0	KSCHOW	19-Jun-04	Update Remote Thermo Sensor Block diagram and description
3.0	KSCHOW	9-Jul-04	Add antenna description
4.0	KSCHOW	5-Mar-05	Update block diagram & security code information

1.4 References

1.5 Terms & Abbreviations

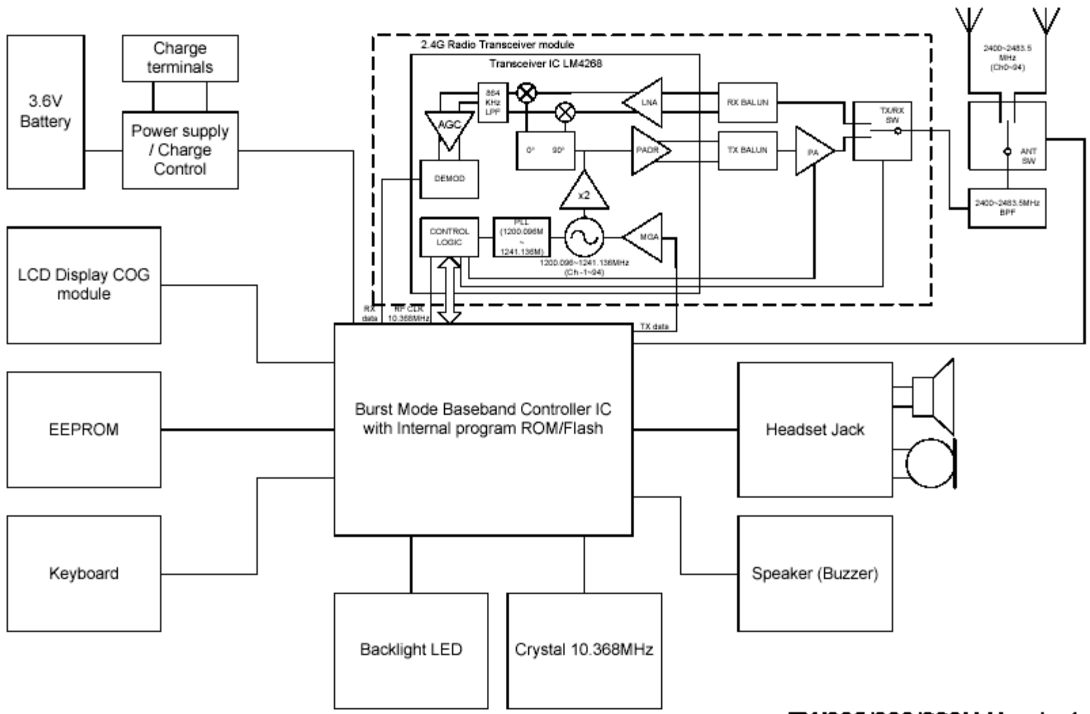
2 Overview

The TW338/339 series are frequency-hopping cordless phone system for the 2.4G ISM band. It supports up to 4 handset and 1 internal / 3 remote thermo sensors (Optional). Some of the key functions are listed below:

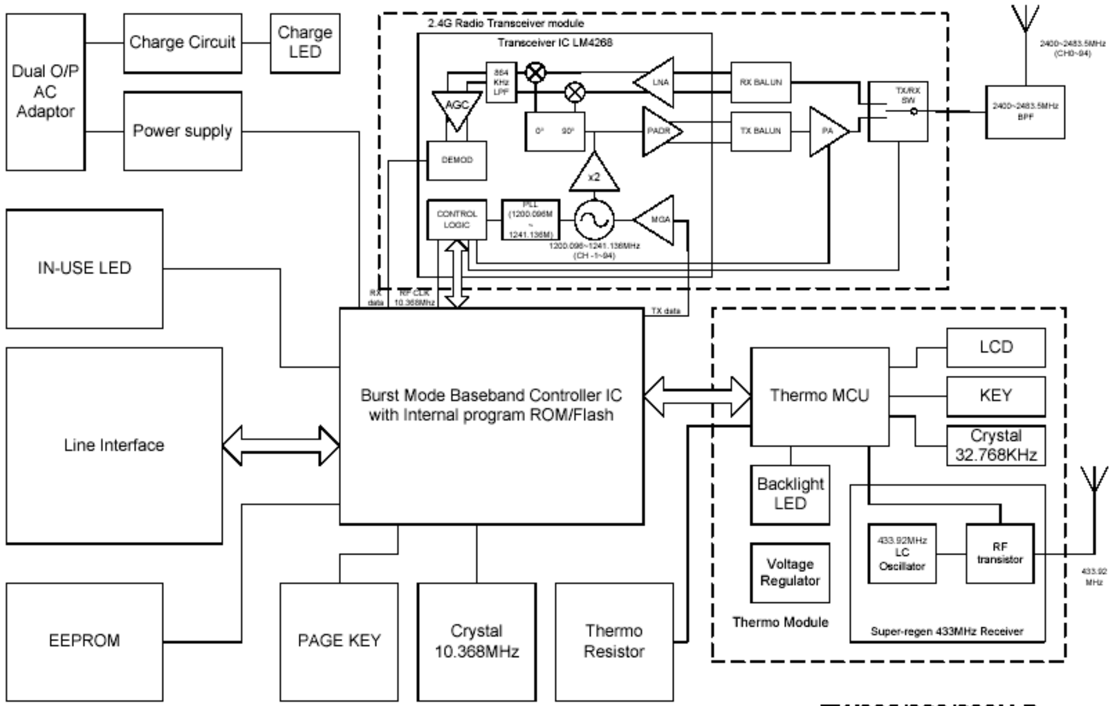
Feature	Supported
Frequency Band	2401.056-2482.272MHz
Number of channels	95
Incoming/outgoing call	Both DTMF and pulse dial
Intercom	Between handsets (via the base station)
Conference call	Two handsets and external
Call forwarding	Transfer call to other handset
Call back	If no reply on call forward
Call waiting at external line during intercom	Audible indication of incoming call during conversation.
Call waiting at external line during another external call.	Audible indication of incoming call during conversation.
Page call	Base station to handsets
Star Call	Calling all other units
Flash	Yes
Handsets per base station	1 to 4
Caller ID (name, number, time/date)	Shows phone book name if matching number is found in the phone book
Phone book	Max. 24 digits incl. pause. Max. 16 characters per name. Max. 70 phone book
Incoming call log	Max. 30 call log
Call log	Max. 13 characters
Last number redial	5
Microphone mute	Yes
Ring-pattern (internal, external)	Up to 10, individually selectable.
Audio Volume control	8 levels
Ring Volume control	6 levels + off
Dial method	DTMF/Pulse dial
Pre-dial	Yes
Any key answer	The keys include HOOK, OFF HOOK, 0-9, * or #
Auto answer	When PP is removed from charger at incoming call.
Auto HOOK ON	When PP is placed in charger.
Battery low indication in handset	Audible and display message
Incoming call indication	Handset ring and display message, base ringing, InUse LED flash.
OFF HOOK indication in handset and base station	LED on base station, display message in handset

Charge indication on base station	LED on base station and handset backlight ON
Key click.	This function would be off when keypad is locked
Key lock	This function is always off after emergency call.
Number of sensor channel	Maximum 3
Remote sensor Range	25m typical in open area
Language	English, Spanish and French

3 Block Diagram



TW338/339/339H Handset Block Diagram



TW338/339/339H Base Unit Block Diagram

4 Circuit Description

4.1 Handset Unit (PP)

The baseband circuit consist primarily of a micro controller with a DECT baseband processor, IC101. It is driven by a 10.368MHz crystal.

The baseband processor handles all audio, signal and data processing needed. It includes CODEC and ADPCM coder/encoder. The baseband processor also include a burst mode controller (BMC) that performs the generation and decoding of the frames used. The BMC also generates the control signals for the radio part.

The baseband processor has a Gaussian filter to perform the filtering of the transmitted data. The output signal (TRADAT) is an analog signal. The baseband receives data signal (RECDAT). The data and clock recovery circuit extracts the timing information form the received signal.

The micro controller handles Keyboard, LED, buzzer, EEPROM IC, LCD driver IC and transceiver IC interface. It also handles power management such as charging and battery voltage detection. It also includes a voltage regulator control circuit to provide 2.5V supply to RF module and micro controller.

The 2.4G RF transceiver includes a low IF DCT transceiver IC LMX4268 and a power amplifier 2303GJ. Please find details on 4.3.

4.2 Basestation Unit (FP)

Similar to handset, the baseband circuit of base station consists primarily of a micro controller with a DECT baseband processor, IC101. It is driven by a 10.368MHz crystal.

The baseband processor handles all audio, signal and data processing needed. It includes CODEC and ADPCM coder/encoder. Echo canceller and echo suppressor are handled by basestation baseband processor.

The baseband processor also include a burst mode controller (BMC) that performs the generation and decoding of the frames used. The BMC also generates the control signals for the radio part.

The baseband processor has a Gaussian filter to perform the filtering of the transmitted data. The output signal (TRADAT) is an analog signal. The baseband receives data signal (RECDAT). The data and clock recovery circuit extracts the timing information form the received signal.

The micro controller handles Keyboard, LED, EEPROM IC, transceiver IC interface and thermo detector MCU interface (optional). It also handles line state monitor such as ringing, tone detection and line voltage detection.

The unit is using a AC adaptor with two isolated output for baseband and charging. The charging circuit is a fully separated circuit that no direct connecting with baseband circuit.

The 2.4G RF transceiver includes a low IF DCT transceiver IC LMX4268 and a power amplifier 2303GJ. Please find details on 4.3.

The heart of thermo sensor is U101 MB89485, which is driven by a 4.1943MHz crystal. It includes thermo detector interface, LCD driver, RF receiver interface and interface with baseband processor. The RF receiver is a superregen receiver that receive 433.92MHz signal from remote thermo sensors.

4.3 2.4G Transceiver Circuit

The transceiver circuit consist primarily of a low IF DCT transceiver IC LMX4268, IC201. It is a highly integrated CMOS chips offering complete transceiver with only few extra components. Because of the low-IF architecture, no IF channel filters are required. The desired channel is translated to a centre frequency of 864kHz using a high-side injection quadrature mixer. The transceiver includes balanced LNA, balanced PA driver, VCO, image-rejected quadrature mixer, variable-gain IF amplifier with AGC, digital demodulator, automatic frequency correction, RSSI detection and 3 logic ports for power amplifier controlling and antenna switching (PP only).

The front end of RF module has two antenna ports. Two pin diodes controlled by the baseband processor are used for routing the desired antenna to the RX/TX path. Preamble antenna diversity, also known as fast antenna diversity, is supported by this solution. RX/TX switching is accomplished using two pin diodes, one in the signal line form the power amplifier, and one at the LNA input. A logic port on the transceiver controls the diodes. When the one of the two diodes are forward biased opening respectively the RX or TX path.

To control the power envelope in transmit mode, the power amplifier supply voltage is switched. A logic port on the transceiver activates the transistors that supply power to the power amplifier.

The integrated PLL uses the 10.368MHz clock signal supplied by the baseband chip as reference frequency. The phase detector operates at 432kHz, which gives a channel spacing of 864kHz, because the prescaler is connected to the VCO output at half the transmit frequency.

The LMX4268 uses open loop modulation, where the Gaussian shaped transmit signal is applied directly to the VCO modulation input. An external loop filter R213, C243 & C248 is placed between the charge pump output and VCO turn input. They are chosen to optimal lock-in time and open loop drift.

Practically all timing during a transmit or receive burst is managed by the Dynamic Control Function (DCF) featured by the transceiver. All the different parts of the chip has its own programmable power controller. The logic ports are equivalent to these power controllers, with the exception that the polarity can be reversed on the logic ports. A burst is initiated by a start Burst-Mode Control Word (BMCW), and optionally ended by a stop BMCW. All times are reset when issuing the start BMCW.

4.4 Temperature Module

The baseband circuit consists primarily of a micro controller MB89485, U100. A 4.1493MHz crystal drives it. It provides thermo detection, LCD driver, RF receiver interface and DSP interface to provide temperature information of remote thermo sensors to handset unit via 2.4G channel.

The receiver is a formed by three parts. On the front end, 433.92MHz RF signal is filtered and amplified via SAW filter F201 and Q200. Then, the RF signal is feed into a superregen receiver formed by Q201, L206 and variable capacitor C217. The demodulated signal is finally re-sharp to digital level with two op-amp, U200.

5 2.4G RF Protocol

5.1 Introduction

TW338/339 series are based on DECT the ETSI standard ETS-300-175-1 to ETS-300-175-9. It is improved by implementing extra features to combat the interference at 2.4 GHz.

The frame format is based on DECT half bit rate and modified from 24 timeslots to 8 timeslots and 95 possible RF carriers. Frequency hopping is implemented on a frame by frame basis. The system is implemented with encryption based on DECT.

5.2 Adaptation to 2.4G ISM band

5.2.1 Frame format:

Down-link (FP to PP) Up-link (PP to FP)

0	1	2	3	4	5	6	7

Length: 10 ms

5.2.2 Crystal frequency 10.368000 MHz

Symbol rate: 576 kbit/sec.
Frame length: 8 timeslots, same as 10 ms.
Frame frequency: 100 Hz
Number of symbols for frame: 5760
Number of symbols per slot: 720 (440 in burst and 280 in guard space)

5.2.3 Frequency Hopping

Slots are used in pairs for duplex bearers (0,4), (1,5), etc. The FP transmits on a frequency in a slot-pair, and the PP responds on the same carrier in the up-link direction. Handset uses preamble antenna diversity to detect the best antenna for reception/transmission.

	Frequency versus slot
Frame	0 1 2 3 4 5 6 7
N	x y x y
N+1	z w z w
N+2	v t v t

5.2.4 Burst Format:

Sync field	A field	B field	XZ	Guard space

5.2.5 Frequency hopping algorithm

The number of used frequencies (NUF) in the hopping algorithm is 95.

In FP and PP exists a PrimaryHoppingIndexNumber (PHIN). This number is incremented modulo NUF in the end of the normal downlink half-frame. It is broadcast in Q0 message instead of PSCN.

To a simplex or an established duplex bearer is assigned a HoppingIndexOffset (HIO), which is analogue to the used RF carrier in a FDMA system. This value is broadcast in place of CN in Q0 message. In the FP in all unused slots in up-link direction the receiver is scanning with HIO=0. The receiver scanning doesn’t exclude RF-carriers.

Different FPs use different hopping sequences. The different sequences are derived from the hopping table by adding an offset, SeQuenceCode (SQC). See section 4.2.2.2.

A hopping table maps an index I to a carrier number: CN = f (I)

The physical RF carrier is calculated by the formula:

CN = (f ((PHIN+HIO) mod NUF) + SQC) mod NUF

5.2.5.1 Excluded Carriers

Excluded carriers (exceptions) are fixed carriers that constantly are interfered by CW RF-carrier. The decision for excluding a RF carrier, are based on:

- RSSI monitor during scanning in the FP.
- Bearer quality in FP correlated to specific RF-carriers.
- Bearer quality detected in PP and reported using Q1 in MAC-header.

When exception carriers are included the complete algorithm is:

I = (PHIN+HIO) mod NUF

CN = (f (I) + SQC) mod NUF

While CN in ExclusionList

{

    I = (I + FreqHopIndexExcpShift) mod NUF

    CN = (f (I) + SQC) mod NUF

}

where FreqHopIndexExcpShift = (NUF-1).

5.2.6 Hopping tables

For 10.368000 MHz crystal the frequencies are derived as:

Frequency: 2401.056 MHz + CN * 0.864000 MHz

i	f(I)	I	f(i)	i	f(i)	i	f(i)	i	f(i)
0	0	20	2	40	27	60	13	80	40
1	23	21	18	41	12	61	33	81	1
2	62	22	81	42	89	62	65	82	28
3	8	23	11	43	25	63	50	83	55
4	43	24	36	44	87	64	79	84	35
5	16	25	72	45	14	65	56	85	53
6	71	26	54	46	57	66	91	86	24
7	47	27	69	47	41	67	42	87	44
8	19	28	21	48	74	68	80	88	82
9	61	29	3	49	32	69	48	89	51
10	76	30	37	50	70	70	15	90	90
11	29	31	10	51	9	71	85	91	38
12	59	32	34	52	58	72	5	92	83
13	22	33	66	53	78	73	88	93	30
14	52	34	7	54	45	74	17	94	46
15	86	35	68	55	20	75	84		
16	63	36	94	56	73	76	6		
17	26	37	75	57	93	77	67		
18	77	38	4	58	64	78	49		
19	31	39	60	59	39	79	92		

5.3 PP Synchronization procedure

PP selects a random RF carrier and tries to receive a frame within 0.9 sec. If nothing is received then a new RF carrier is selected.

When a burst with correct A-CRC is received and it is a Nt (RFPI) the hopping sequence (SQC) is known and the PP must receive in the following frames using the hopping sequence. If the received A-field is different from a Nt, the PP selects a new RF carrier randomly and waits for Nt. In this state the PP do not have information of excluded RF carriers, but just follows the known hopping sequence without excluding any RF carriers. Only individual frames are missed on the excluded carriers. When PT3 is received, the PP is able to receive on exception carriers.

5.3.1 Dual slot diversity

Dual slot diversity is activated in case interference is detected. That is, two bearers are active, carrying the same B-field content. The receiver decides which of the received speech frames to use, depending on A-CRC and/or X-CRC. The setup and release of the 2nd bearer are performed dynamically by the FP-MAC and PP-MAC to adapt to current interference level.

The two bearers are managed independently in the MAC, like a stalled intra-cell bearer hand-over with two established bearers. HoppingIndexOffset (HIO) for the two bearers are selected independently.

5.4 Power amplifier activation

5.4.1 External connection

The FP has one connection active at all times to make synchronization of the PP possible. In case a speech connection is active one slot will be active in down-link direction and one slot will be active from in up-link direction. The power amplifier will be active from start of sync field to the end of XZ field, which is slightly less than 1/12 of the total frame. In case dual slot diversity is active, two slots will be active equal to 2/12 of a frame.

5.4.2 Internal connection

Two handsets are able to make an internal connection. In this case two bearers will be active in the down-link direction from FP, and one bearer will be active from each handset. The two bearers in down-link direction are not correlated and uses different HoppingIndeOffset. Dual slot diversity is activated independently towards each handset, i.e. up to four bearers may be activated in down-link direction, and two bearer may be active in up-link direction.

5.5 Security

TW338/339 series security system is based on DECT ETSI standard ETS-300-175-6— Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 6: Identities and addressing. The core of radio security is a 40 bits MAC layer identity codes (RFPI), which will be described on following paragraphs. The 17bits Fix Part Number(FPN) of RPFI is generated randomly in manufacturing and stored in EEPROM.

5.5.1 General Description of FP and PP identities

Every radio FP broadcasts for its purpose a unique identity which contains a globally unique (to a service provider) Access Rights Identity (ARI). Every PP has both a Portable Access Rights Key (PARK) and an International Portable User Identity (IPUI). These operate as a pair. A PP is allowed to access any radio FP which broadcasts an ARI that can be identified by any of the portable access rights keys of that PP.

The IPUI is used to identify the portable in the domain defined by its related ARI. The IPUI can either be locally unique or globally unique.

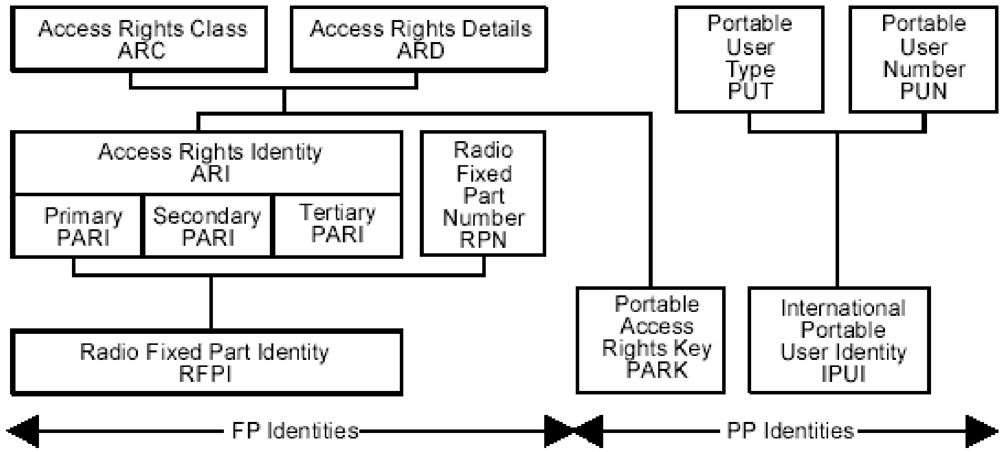


Figure 1 General identity structure

The common base for the DECT identity structure is the Access Rights Class (ARC) and Access Rights Details (ARD). These need to be known by both the FP and the PPs. In the FP the ARC and ARD are called Access Rights Identity (ARI), and in the PP they are called Portable Access Rights Key (PARK). The distinction between PARK and ARI is that each PARK can have a group of ARDs allocated, PARK{y}. "y" is the value of the PARK length indicator given in the PP subscription process.

Figure 2 Structure of PARK{y}

If the ARI is a primary ARI, i.e. PARI, it will form, together with a RFP number, the broadcast identity RFPI. ARIs can also be less frequently broadcast as Secondary Access Rights Identities (SARIs) and may also be available as Tertiary Access Rights Identities (TARIs), which are not broadcast, but are accessible upon request.

The PUT and PUN form the PP user's identity, IPUI. This identity can either be globally unique or locally unique. In addition to IPUIs, shorter temporary identities, TPUIs, may be used for paging.

A PP is identified by its pairs of PARK{y} and IPUI. A PP is only allowed to access a FP if one of its PARKs includes one of the ARIs of the FP, i.e. the PARI, a SARI or a TARI.

5.5.2 FP identities

FP identities are used to inform PPs about the identity of a DECT FP and the access rights to that DECT FP and thereby reduce the number of access attempts from unauthorized portables.

A DECT FP broadcasts this information on the NT-channel via all its radio FPs, at least once per multiframe. A PP needs to be able to interpret necessary parts of this broadcast information to detect the access rights to a system or even access rights agreements between system operators, i.e. operators A and B have a bilateral agreement permitting their users to roam between their systems. These agreements can change and cannot therefore be stored in PPs without updating them frequently. Therefore the FP handles access rights information which is embedded in the identity structure.

The base for the identity structure is formed by the ARCs and the ARDs.

ARC: shows the type of access to a DECT network, such as public, private or residential.
ARD: this number is unique to the service provider. Its structure depends on the ARC. The ARC and ARD together form the basic identity, the ARI:
ARI: this identity is globally unique to a service provider, and shows the access rights related to this service provider. This identity may be applied to any number of FP installations. There are three categories of ARIs.
PARI: primary ARI has to be broadcast. This is also the most frequently broadcast ARI in order to give a higher grade of service to users with these access rights. The PARI is broadcast over the NT-channel. The PARI (in conjunction with RPN) also carries information about domains of handover and location areas.
SARI: secondary ARI. SARIs are less frequently broadcast than PARIs. They are sent as a SARI-list on the QT-channel.
TARI: tertiary ARI. The TARI is not broadcast at all and is only available as a (or in a) "TARI reply" message, which is an answer to a "TARI request" message including the relevant PARK{y}.

The classification of primary, secondary and tertiary access rights gives the possibility for operators or system owners to offer their subscribers/users an almost unlimited list of roaming agreements. This classification can be seen as an iceberg with the PARI visible on the top followed by a less visible SARI list and in the depth the invisible TARIs.

Figure 3 Structure of ARI

ARC: 8 available classes named A - H. Only classes A - E are currently defined.
ARD: details, depends on the ARC.
One ARI together with a radio FP number, forms the RFPI. The ARI embedded in the RFPI is the PARI.

The RFPI is frequently transmitted as bits a8 to a47 in the A-field using the NT-channel and has therefore a limitation of 40 bits.

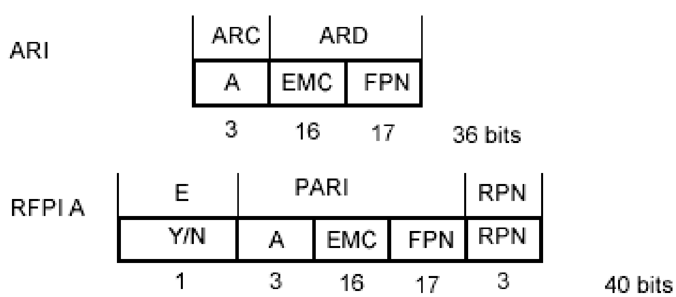


Figure 4 ARI and RFPI

E: this field indicates if there are any SARIs available. Value yes or no.
A: Access rights class A
EMC: Equipment Manufacturer's Code, set to 0 at manufacturing

FPN: Fixed Part Number, random generated at manufacturing. It has an upper limit of 131071, which gives a total of over 8.5 billion unique ARIs.
RPN: Radio fixed Part Number, this number is allocated by the manufacturer/installer and is used to separate a maximum of 7 different cells from each other. In case of single cell FPs, RPN = 0. This indicates for a PP that this FP does not have intercell handover, since there is only one RFP.

5.5.3 PP identities

PP identities have two main purposes, first to enable a PP to select a valid DECT FP and second to uniquely identify the PP within that DECT FP. For these purposes there are two identities defined.

These identities are the PARK, and the IPUI. A PP shall have at least one PARK{y} and an IPUI.

PARK: the PARK{y} defines the access rights for a PP. "y" is the value of its PLI. The structure of the PARK is same as an ARI.

PLI: associates a group of FP ARIs to the PARK, by indicating how many bits out of the ARC + ARD bits are relevant. The rest of the bits have "don't care" status. The PLI is programmed into a PP as part of the subscription process.

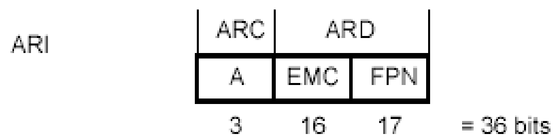


Figure 5 PARK structure

6 Frequency Channel Allocation

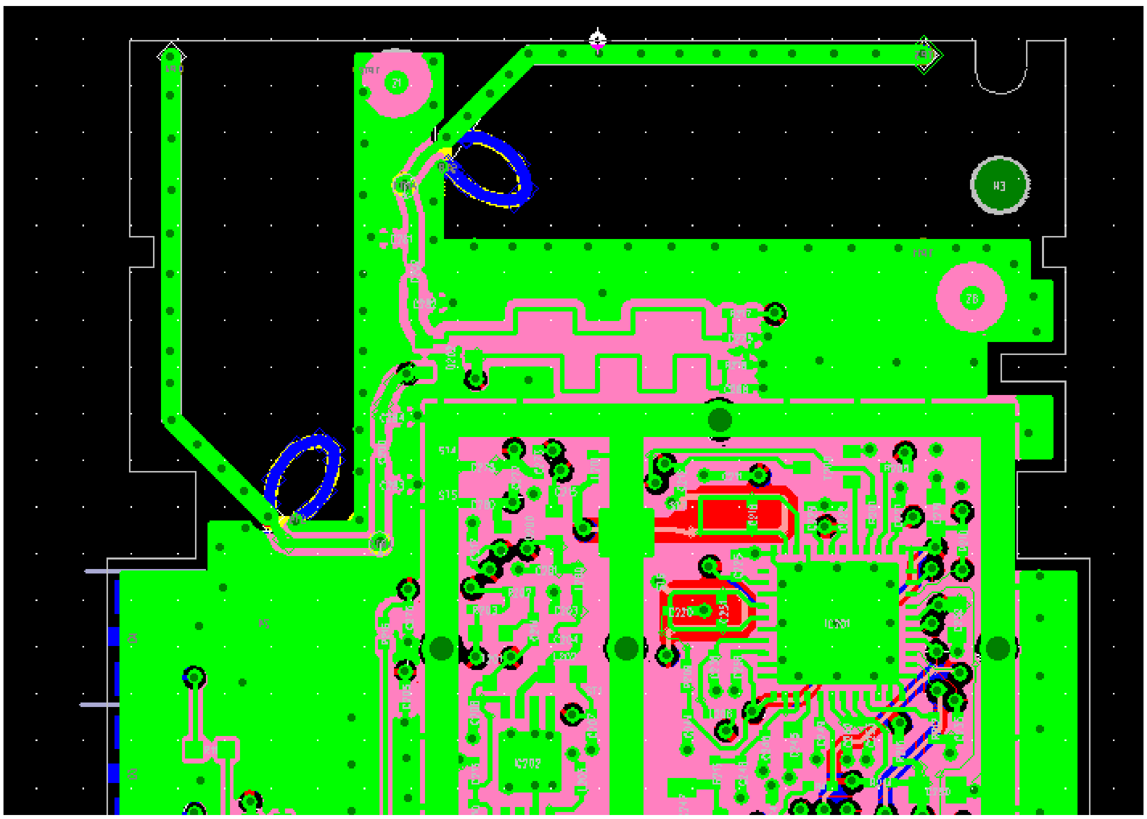
Channel	Frequency	Channel	Frequency
0	2401.0560	48	2442.5280
1	2401.9200	49	2443.3920
2	2402.7840	50	2444.2560
3	2403.6480	51	2445.1200
4	2404.5120	52	2445.9840
5	2405.3760	53	2446.8480
6	2406.2400	54	2447.7120
7	2407.1040	55	2448.5760
8	2407.9680	56	2449.4400
9	2408.8320	57	2450.3040
10	2409.6960	58	2451.1680
11	2410.5600	59	2452.0320
12	2411.4240	60	2452.8960
13	2412.2880	61	2453.7600
14	2413.1520	62	2454.6240
15	2414.0160	63	2455.4880
16	2414.8800	64	2456.3520
17	2415.7440	65	2457.2160
18	2416.6080	66	2458.0800
19	2417.4720	67	2458.9440
20	2418.3360	68	2459.8080
21	2419.2000	69	2460.6720
22	2420.0640	70	2461.5360
23	2420.9280	71	2462.4000
24	2421.7920	72	2463.2640
25	2422.6560	73	2464.1280
26	2423.5200	74	2464.9920
27	2424.3840	75	2465.8560
28	2425.2480	76	2466.7200
29	2426.1120	77	2467.5840
30	2426.9760	78	2468.4480
31	2427.8400	79	2469.3120
32	2428.7040	80	2470.1760
33	2429.5680	81	2471.0400
34	2430.4320	82	2471.9040
35	2431.2960	83	2472.7680
36	2432.1600	84	2473.6320
37	2433.0240	85	2474.4960
38	2433.8880	86	2475.3600
39	2434.7520	87	2476.2240
40	2435.6160	88	2477.0880
41	2436.4800	89	2477.9520
42	2437.3440	90	2478.8160
43	2438.2080	91	2479.6800
44	2439.0720	92	2480.5440
45	2439.9360	93	2481.4080
46	2440.8000	94	2482.2720
47	**2441.664**		

7 Antenna Description

Both Handset and Base antenna of TW338/339 series is internal antenna. They are ¼ wave dipole antenna located on same 4-layer PCB with RF transceiver IC and RF power amplifier. Typical characteristic:

Operating frequency:	2400~2485MHz
Impedance:	50 +/- 10 Ohm
VSWR:	<2.0:1
Gain:	1.5dBi (estimated)

7.1 Handset Unit (PP)

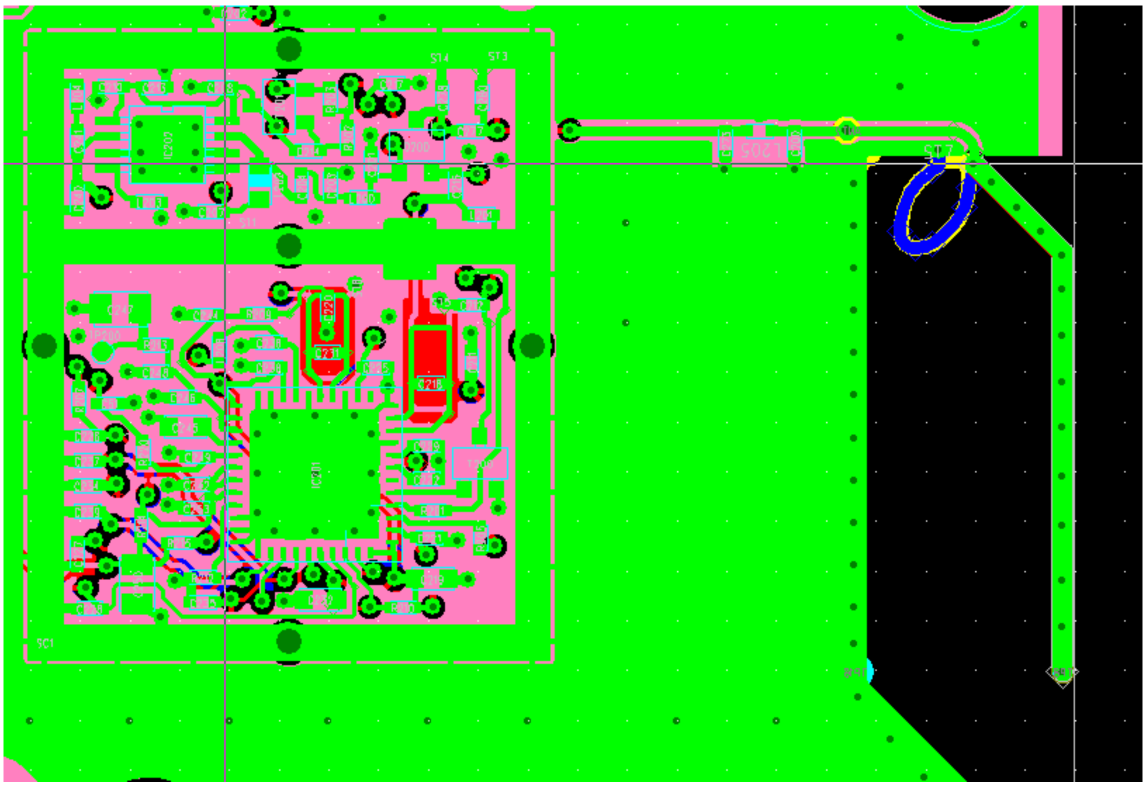


Handset 2.4G RF transceiver modules includes a low IF DCT transceiver IC LMX4268 and a power amplifier 2303GJ and two antenna ports (antenna 0 and 1). Please find detail on above diagram. A two pin diodes D202, BAR64-05W controlled by the baseband processor are used for routing the desired antenna to the RX/TX path. Preamble antenna diversity, also known as fast antenna diversity, is supported by this solution. RX/TX switching is accomplished using two pin diodes D200, BAR64-05W, one in the signal line form the power amplifier, and one at the LNA input.

Those diodes are controlled by DSP via microwire interface to transceiver IC. Some logic ports on the transceiver controls the diodes. When the one of the two diodes are forward biased opening respectively the RX or TX path and antenna 0 or 1.

Antenna 0 and 1 are located with 90^{o} shifted. Only antenna 0 or 1 will be used to send or receive signal once a time, which is dependent on received RSSI signal level of the latest signal burst. If the received RSSI level is less than a predetermined level, another antenna will be used on the coming frame to solve multi-path problem of the system.

7.2 Basestation Unit (FP)



Similar to handset, the base station 2.4G RF transceiver module includes a low IF DCT transceiver IC LMX4268 and a power amplifier 2303GJ, but only one antenna are used. Please find detail on above diagram.

7.3 Duty factor

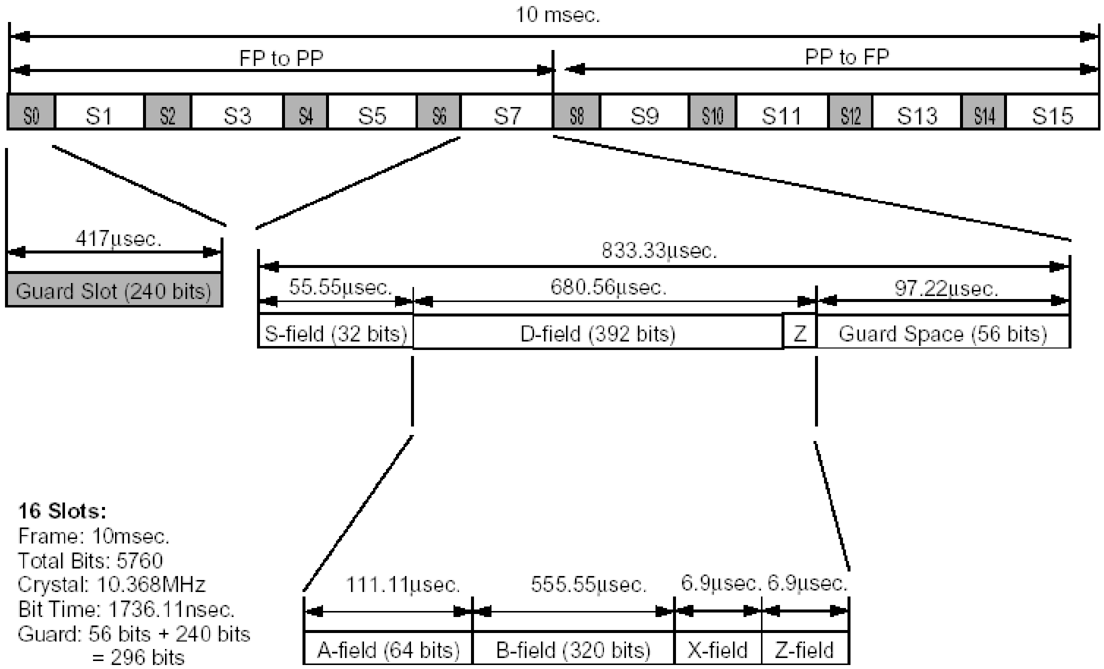


FIGURE 7. WDCT Slot- and Frame-Timing

The TW338/339 series are frequency hopping spread spectrum systems in the ISM2.4 that fulfill n FCC 47 CFR §15.247(b)(4) that these devices must operate in a manner that ensures the public is not exposed to RF energy levels in excess of the Commission's guidelines. Followings are some key parameters:

- The FHSS-systems shall use 95 non-overlapping hopping frequencies
- The maximum allowed 20dB bandwidth is 1MHz.
- The average time of occupancy on any frequency is 10mS per second.
- The duty cycle is 833.33uS over 10mS = 0.08333 or -20dB(max)

National Semiconductor

ADVANCED INFORMATION

March 2004

LMX4268
Radio Transceiver for DECT

1.0 General description

The LMX4268 is a radio transceiver integrated circuit optimized for the Digital Cordless Telecommunications (DCT) system. The transceiver, when combined with a power amplifier and a Tx/Rx switch, implements a complete 2.4GHz ISM band digital radio transceiver compliant with the FCC rules part 15. The LMX4268 interfaces directly to National Semiconductor's SC144XX DCT family of baseband processors.

The LMX4268 integrates a complete transmitter, consisting of a phase locked loop, VCO and PA driver. The receiver contains LNA, quadrature downconverter, polyphase filter, automatic gain control and demodulator.

The LMX4268 operates from a single 2.5V supply. The LMX4268 is manufactured in National's 0.25µm CMOS technology, and is packaged in a 44 pin LLP package.

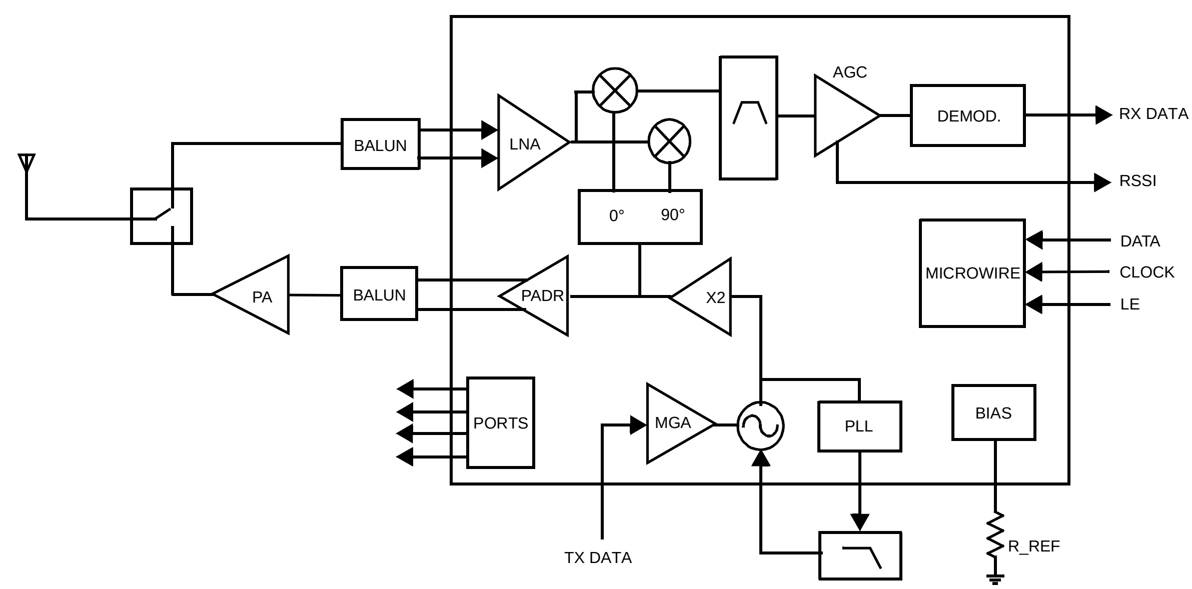
2.0 Features

- Fully integrated 2.4 GHz CMOS low-IF transceiver
- Low power consumption
- On-chip Voltage Controlled Oscillator (VCO)
- On-chip low noise amplifier (LNA)
- Open-loop modulation
- On chip Modulation Gain Amplifier (MGA)
- On-chip timing control
- Four digital (5 mA) output ports
- 0 dBm PA driver output
- dual bit rate 0.576 MHz (LR_b) / 1.152 MHz (HR_b)
- sensitivity -96 dBm (LR_b) / -93 dBm (HR_b)
- 2.5V operation
- Small 44 pin Leadless Leadframe Package

3.0 Applications

- (DCT) Digital Cordless Telecommunications

4.0 System Diagram



5.0 Specifications

5.1 ABSOLUTE MAXIMUM RATINGS

Table 1. Absolute Maximum Ratings [1,2]

Parameter	Description	Min	Typ	Max	Units
Vdd_{max}	Power Supply Voltage (Vdd_shield, Vdd_ADC, Vdd_mix, Vdd_LNA, Vdd_ESD, Vdd_PAdr, Vdd_presc, Vdd_PLL, Vdd_VCO, Vdd_bias, Vdd_dig, Vdd_RSSI)	-0.3	-	3.0	V
	Absolute difference between power supplies	-	-	0.3	V
Vn_{max}	Voltage on any pin	-0.3	-	Vdd+0.3	V
$T_{storage}$	Storage Temperature	-40	-	+150	°C
T_{Lead}	Lead Temp. (solder 4 sec)[3]	-	-	+260	°C
V_{HBM}	ESD - human body model [4]	-	-	2.0	kV
V_{MM}	ESD - machine model [4]	-	-	200	V

1. *tbc* = To be characterized
2. Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical Characteristics. The guaranteed specifications apply only to the test conditions listed.
3. MSL 2 (Moisture Sensitivity Level) is valid when the standard reflow process (235°C) is used. MSL 2 means 1 year shelf life after opening dry-pack. MSL 2(1 year shelf life) is also valid when the leadfree reflow process (260°C) is used. Storage conditions are max. 30°C / 60% rel. humidity.
4. ESD STATEMENT
   This device is a high performance RF integrated circuit and is ESD sensitive. Handling and assembly of this device should be performed at ESD free workstations.

5.2 ELECTRICAL CHARACTERISTICS

Table 2. Recommended Operating Conditions

Parameter	Description	Min	Typ	Max	Units
Vdd	Power Supply Voltage (Vdd_shield, Vdd_ADC, Vdd_mix, Vdd_LNA, Vdd_ESD, Vdd_PAdr, Vdd_presc, Vdd_PLL, Vdd_VCO, Vdd_bias, Vdd_dig, Vdd_RSSI)	2.25	2.5	2.75	V
V_{TXout}	PA driver output biasing voltage on pins TXoutZ, TXout	-	2.0	-	V
T_a	Operating ambient temperature	-20	-	+70	°C
R_ref	Reference resistor connected from pin 31 to Vss (see Table 1)	61	62	63	kΩ

6.0 Product Status Definitions

Datasheet Status	Product Status	Definition
Advance Information	Formative or in Design	This data sheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	This data sheet contains preliminary data. Supplementary data will be published at a later date. National Semiconductor Corporation reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.
No Identification Noted	Full production	This data sheet contains final specifications. National Semiconductor Corporation reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.
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7.0 Package Information inches (millimeters) unless otherwise noted

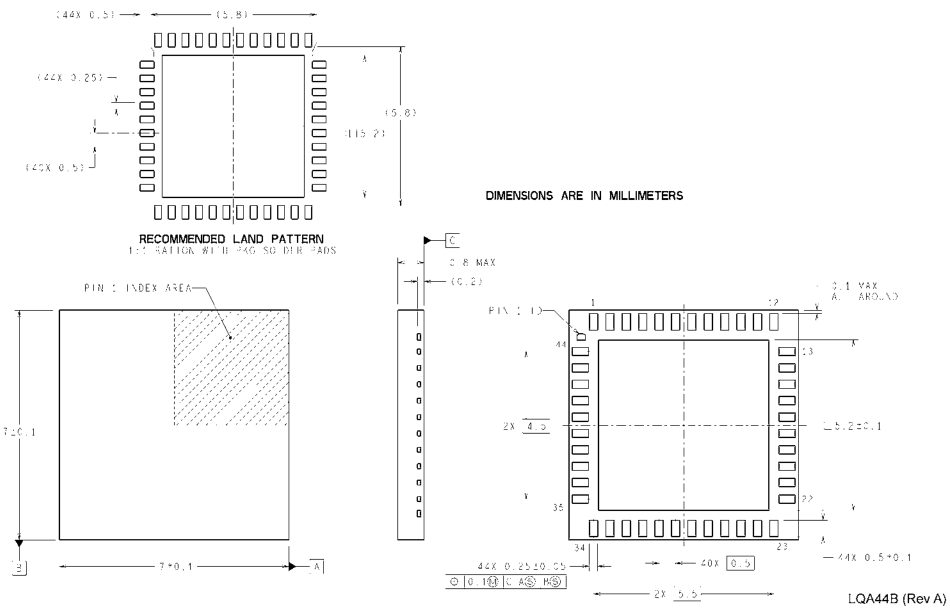

Figure 1. 44 pins Leadless Leadframe Package - NS Package Number LQA44

Note: Refer to the application note AN-1187 for relevant soldering information.
This document can be downloaded from *http://www.national.com/an/AN/AN-1187.pdf*

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