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Infrared Remote Control Transmitter IC **PT2215**

DESCRIPTION

PT2215 is a remote control transmitter utilizing CMOS Technology specially designed for RC5 infrared remote control applications. Although PT2215 does not contain a software programming processor, it however has a ROM which can store the codes that have been transmitted. PT2215 provides an option for a single or multi system transmitter. A single system has up to a maximum of 8 different systems per chip whereby selection is via jumper wire or switch. The multi system option provides a maximum of 8 systems via key selection. Pin assignments and application circuit are optimized for easy PCB layout and cost saving advantages.

FEATURES

- CMOS technology
- RC5 protocol
- Maximum of 56 keys
- Multi-system or single system transmitter option
- Power down and key wake up functions
- High output current (< 45mA)
- Oscillation frequency: 432KHz or 4MHz
- Multiple key protection
- 25% or 33% duty factor option
- Available in 20 pins, SOP package

APPLICATIONS

- Air conditioner
- Television
- VCR
- Audio equipment
- Multi-media system

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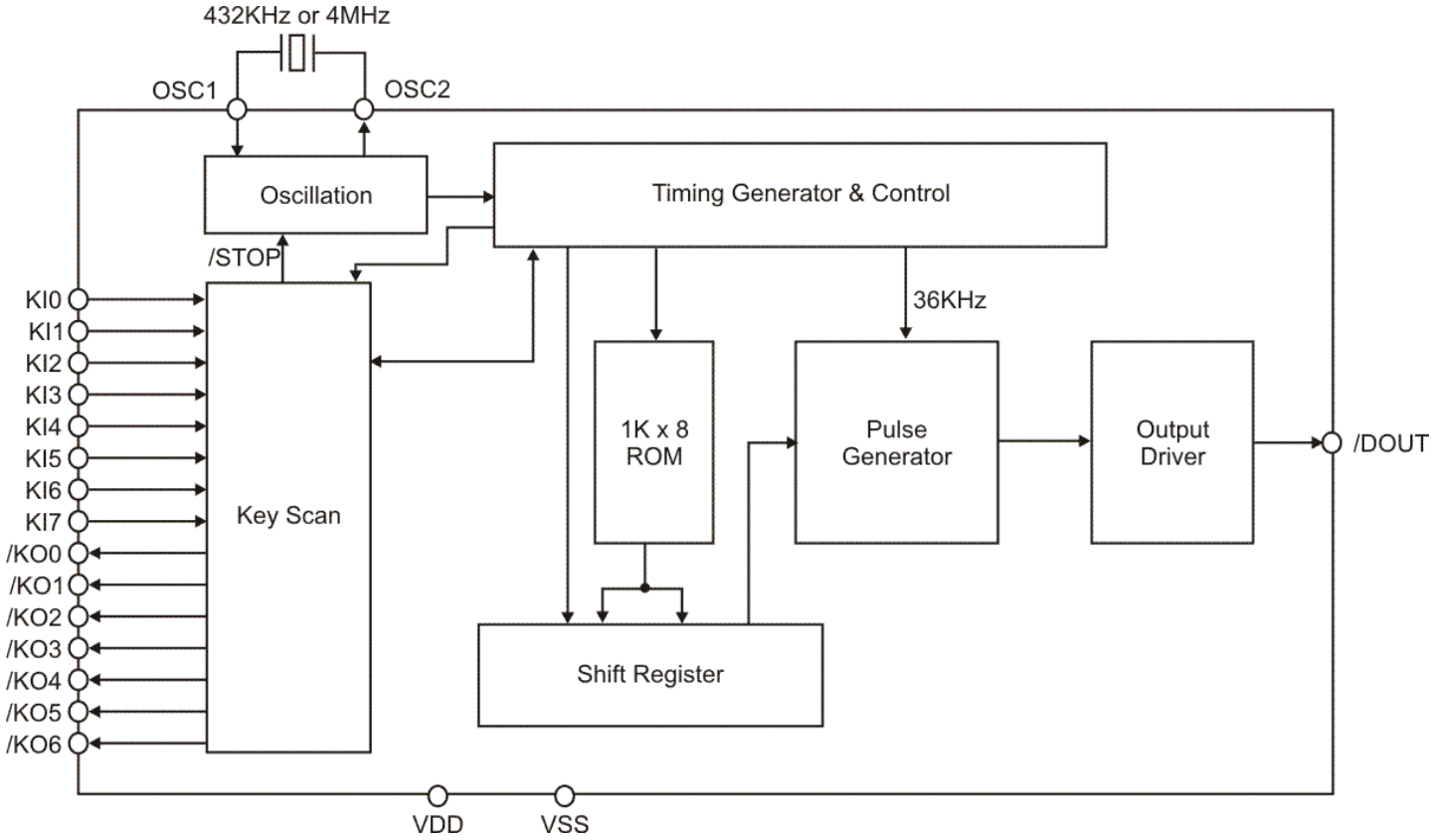
BLOCK DIAGRAM



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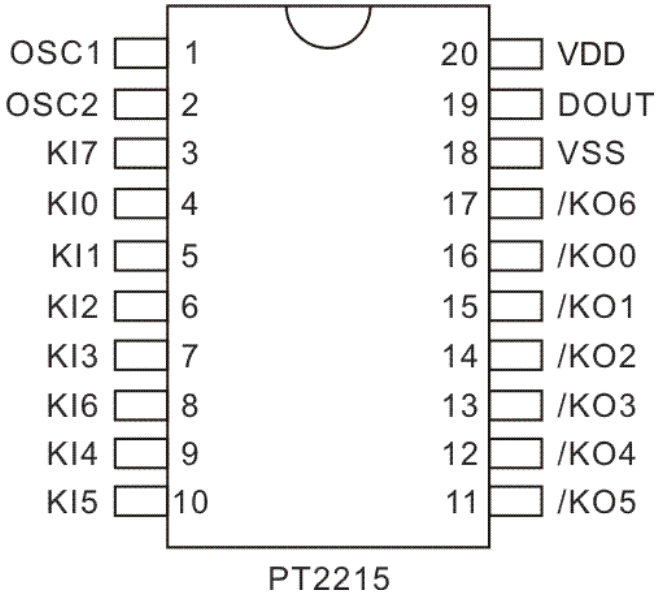
PIN CONFIGURATION



PIN DESCRIPTION

Pin Name	I/O	Description	Pin No.
OSC1	I	Oscillator Input Pin	1
OSC2	O	Oscillator Output Pin	2
KI7	I	Key Matrix Sense Line 7	3
KI0	I	Key Matrix Sense Line 0	4
KI1	I	Key Matrix Sense Line 1	5
KI2	I	Key Matrix Sense Line 2	6
KI3	I	Key Matrix Sense Line 3	7
KI6	I	Key Matrix Sense Line 6	8
KI4	I	Key Matrix Sense Line 4	9
KI5	I	Key Matrix Sense Line 5	10
/KO5	O	Key Matrix Drive Line 5 (Active: Low)	11
/KO4	O	Key Matrix Drive Line 4 (Active: Low)	12
/KO3	O	Key Matrix Drive Line 3 (Active: Low)	13
/KO2	O	Key Matrix Drive Line 2 (Active: Low)	14
/KO1	O	Key Matrix Drive Line 1 (Active: Low)	15
/KO0	O	Key Matrix Drive Line 0 (Active: Low)	16
/KO6	O	Key Matrix Drive Line 6 (Active: Low)	17
VSS	-	Ground	18
/DOUT	O	Output SUGNAL (Active: Low)	19
VDD	-	Power Supply	20

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FUNCTION DESCRIPTION

When a key is pressed, PT2215 generates output pulses in compliant with the RC5 protocol. PT2215 does not have a software programmable processor but contains a ROM which is used for storing the codes that have been transmitted. A 432KHz or 4MHz oscillation frequency may be selected. External capacitors must be connected to generated the 432KHz oscillation frequency.

When a key belonging to the key matrix is pressed, a drive line is connected to a Sense Line. This will then activate the oscillation and a corresponding code will be generated in accordance with the RC5 protocol. Up to 7 drive lines (/KO0 to /KO6) may be connected to up to eight sense lines (KI0 to KI7) in order to construct a key matrix. Please refer to the tables below.

KEY MATRIX FOR 20 PINS PACKAGE

Driver Lines	Sense Lines							
	KI0	KI1	KI2	KI3	KI4	KI5	KI6	KI7
/KO0	0	1	2	3	4	5	6	7
/KO1	8	9	10	11	12	13	14	15
/KO2	16	17	18	19	20	21	22	23
/KO3	24	25	26	27	28	29	30	31
/KO4	32	33	34	35	36	37	38	39
/KO5	40	41	42	43	44	45	46	47
/KO6	48	49	50	51	52	53	54	55

After the key scanning operation has been completed, the key number of the activated keys are used as the address of the ROM. For a 16-pin PT2215 version, the following sense and driver lines are not connected -- KI6, KI7, /KO5 and /KO6. Therefore, key numbers 6, 7, 14, 15, 22, 23, 30, 31, 38, 39 and 40 to 55 are not used.

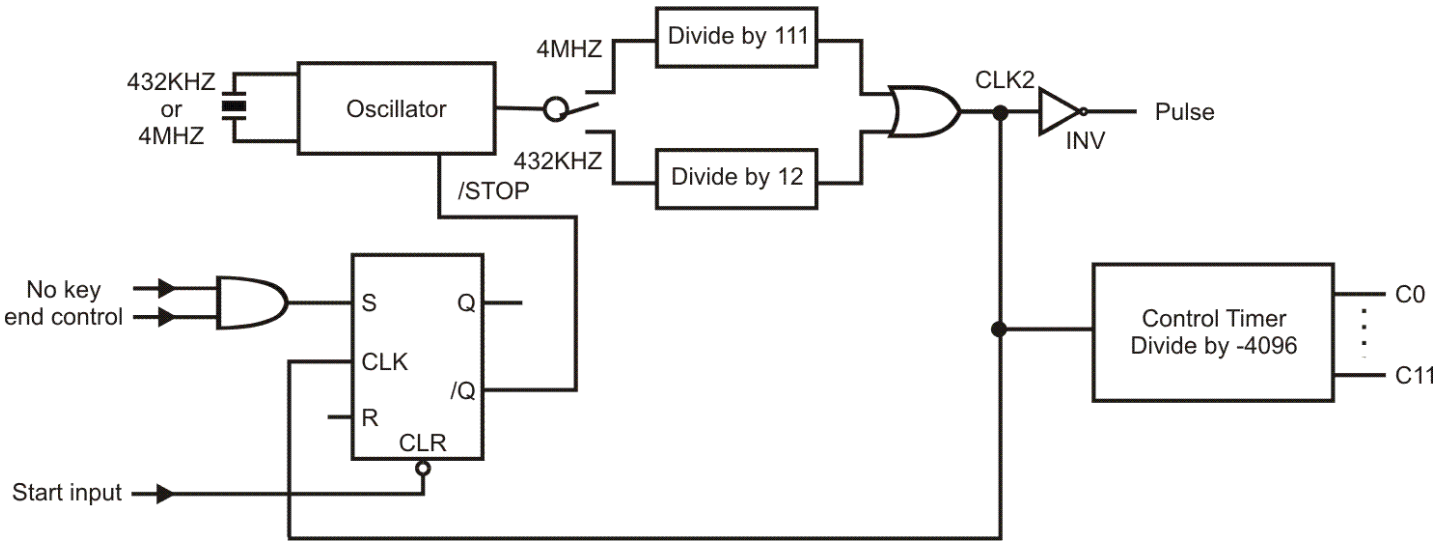
The ROM contains 8 banks of 64 code words. Each key can generate a maximum of 8 different code words. A multi-system can select 8 different systems (i,e, TV, VCR, Tuner, CD, DVD etc.). PT2215 can supports a truly multi-function key. The system bits as well as the command bits may be different in the different banks. The keys may be used to perform the selection. Each key has 3 bank select bits which are used to determine which bank will be selected for the next key and an “inhibit bit”. When the “inhibit” bit is set to “1” at a given bank and the corresponding key is press (that is, this given bank has been selected.), there will be no transmission.

In the case of a single system, the bank selection is made via a jumper wire or a switch. Using the single system option, it is possible to program different transmitter models in one PT2215 chip. A side-switch may be used instead of a jumper wire to change the generated code temporarily to obtain multi-functional keys. The jumper wires or switch must be connected between the sense line KI0 and one of the drive lines /KO0 to /KO6 or the Ground. KI0 cannot be used to connect keys. For a PT2215 16-pin package, the maximum number of keys is 25 while for a 20-pin package, the maximum number of keys is 49.

It is important to note that it is not possible to use a combination of jumper wires and selection keys in a one unit bank selection.

TIMING GENERATOR

The timing generator diagram is shown in the figure below. The oscillation frequency value is 432KHz or 4MHz. The timing generator is terminated when no key is activated, however, it commences when a key is pressed.



As you can see from the diagram above, the CLK1 (Oscillator Output) is divided by either 111 (for 4MHz) or by 12 (for 432KHz) depending on your mask option. CLK2 is used to control timer clocking. The frequency of CLK2 is 36KHz and its inverse is used to generate the output pulses in the subcarrier frequnecy. The duty factor may either be 25% or 33% depending on the mask option.

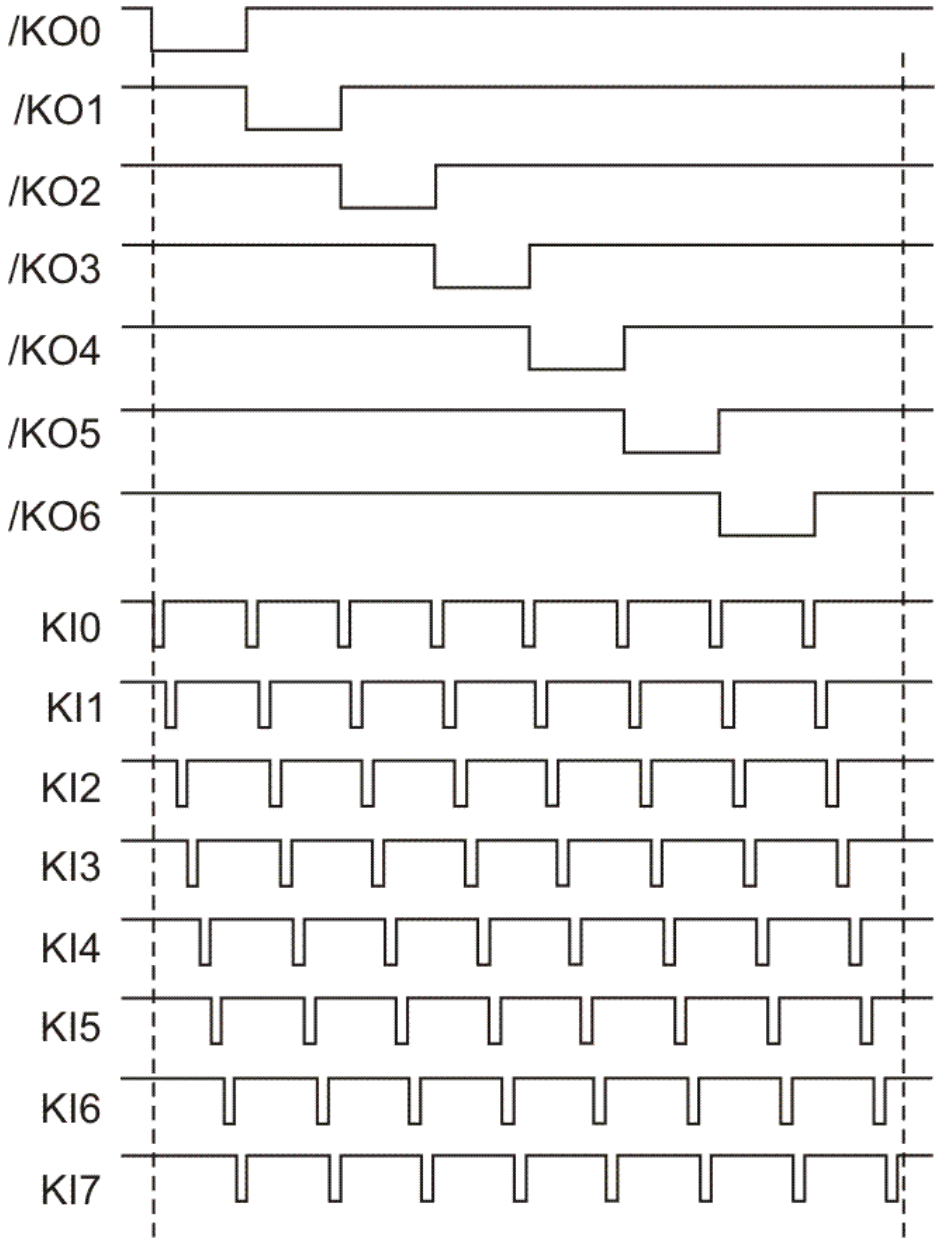
The control timer provides the timing of the key scanning, ROM access and Code transmission. The length of the control timer is 4,096 subcarrier (pulse) periods which is equivalent to the transmission repetition time. One bit time is equal to 64 pulse while on repetition time has 64 bit times. When the control timer has arrived at a certain state and no key has been pressed, a stop signal is generated which will terminate the oscillator. All drives will then be set to “LOW”. Pressing a key will set one of the sense lines to “0” and this will generate a start signal which will restart the oscillator.

PULSE OUTPUT

The remote control word bits (as indicated by the addressed ROM locations) are stored into a shift register every bit-time this register is shifted. The output is used to generate either “0” or “1” in the biphase (Manchester) coding modulated with a 36KHz frequency. The duty factor of the modulation pulses may be optionally selected to be either 25% or 33.3%. The pulse generator output controls the output driver that provides the maximum current of 45mA.

KEY SCANNING

Key Scanning is controlled by six bits of the control timer, thus, 64 time slots are available. Each time slot correspond to a key number. The three most significant bits (MSBs) control the drive lines while the 3 least significant bits (LSBs) control the sense lines. The scan timing diagram is shown in the diagram below.



In the first 8 time slots, the drive line -- /KO0 is set to “LOW”. During this time, the 8 sense lines -- KI0 to KI7 are sequentially tested. In the next 8 time slots, the drive line -- KO1 is set to “LOW” and during this time, the 8 sense lines are sequentially tested. The same thing occurs for the succeeding 8 time slots /KO2, /KO3, /KO4, /KO5 or /KO6 are set to “LOW”. After testing, there are 8 time slots when all drive lines are “HIGH”.

When one of the sense lines of time slots 0 to 63 is set to “LOW”, the contents of the 6 bits are stored in the key register which is used to address the ROM.

When two or more keys are activated, no transmission occurs. Under this condition which is the same as “No Key”, the control bit in the command word for the next transmission will be toggled. When no keys is pressed the oscillation is terminated at the of the control timer. Under this condition, all drive lines will be set to “0”. When one of the keys is pressed once again, the oscillation is start, thus, a wake up will occur.

SYSTEM OPTIONS

PT2215 provides two system options: single system and the Multi-System.

SINGLE SYSTEM

In a single system, the KI0 must be connected to the ground or to one of the drive lines. The bank selected is the equivalent to the drive line number to which the KI0 is connected. When the KI0 is connected to the ground, the bank selected is 7. The bank select flip-flops are loaded with the contents of control timer’s C5 to C7 when the KI0 is set to “0”. It is therefore possible to have two different systems in one transmitter by using a side switch. It must be noted that KI0 cannot be used to connect keys, thus the maximum number of keys for a 20-pin package is 49.

MULTI-SYSTEM

In a multi-system, the bank is selected via key selection. A maximum of eight (8) different systems (i.e. TV, VCR, CD, DVD, etc.) is supported. When the system in initialized (i.e. user inserts new battery), the default bank is always Bank 7. If only bank 7 is set, the maximum number of keys for a 20-pin package is 56.

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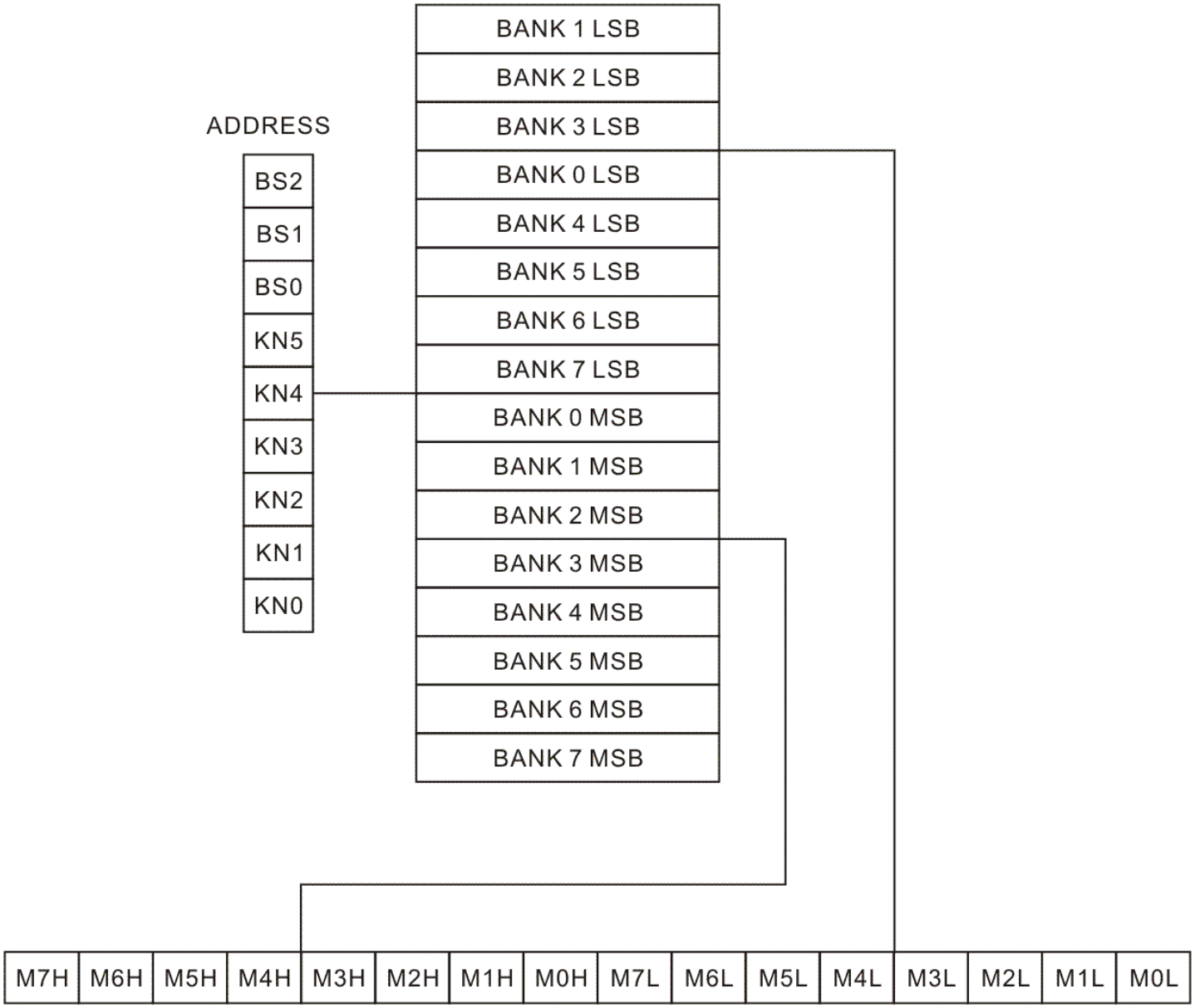
ROM

The ROM consists of 8 banks. Each bank provides 2 x 64 bytes. Please refer to the diagram below.



A bank is selected by using flip flops BS0 to BS2 which are the 3 highest address bits. In a single system, these bits are loaded from the 3 MSBs of the Scan Control when KI0 = ”0”. During Power-On, the bank select flip-flops will be in an arbitrary state.

When a key is activated, the key number if stored in the 6-bit key register. This register forms the lower bits of the ROM Address. For each command, the ROM will be accessed twice giving a total of 16 bits (M0L to M7L and M0H to M7H). The table below describes these bits.

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040 ROM TABLE

Scan	Bank0		Bank1		Bank2		Bank3		Bank4		Bank5		Bank6		Bank7	
1	7	83	4	46	11	36	20	43	20	29	0	109	0	109	0	50
2	7	82	4	29	11	19	20	29	17	31	0	108	0	108	0	54
3	7	44	4	31	11	18	20	50	17	30	0	107	0	107	0	55
4	0	12	4	96	11	12	20	63	20	12	0	12	0	12	0	12
5	7	17	4	108	11	37	20	108	20	28	0	111	0	111	0	53
6	7	30	4	45	11	15	20	45	20	107	0	126	0	126	0	126
7	7	16	4	28	11	13	20	28	20	43	0	110	0	110	0	52
9	7	78	4	3	11	03	20	03	20	03	0	03	0	03	0	03
10	7	77	4	33	11	91	20	33	20	33	0	38	0	97	0	38
11	0	86	4	32	11	89	20	32	20	32	0	86	0	86	0	16
12	7	58	4	79	11	32	21	63	20	45	0	14	0	14	0	14
13	7	23	4	9	11	09	20	09	20	09	0	09	0	09	0	09
14	0	36	4	53	11	33	20	53	20	53	0	36	0	36	0	36
15	7	22	4	6	11	06	20	06	20	06	0	06	0	06	0	06
17	7	68	4	116	11	26	16	13	20	26	0	44	0	44	0	44
18	7	29	4	10	11	41	20	11	17	63	0	16	0	89	0	89
19			4	113	11	126	16	79	20	59			0	101		
20	7	69	4	76	11	22	17	43	16	22	0	43	0	43	0	43
21	7	54	4	119	11	23	17	31	16	23	0	42	0	42	0	42
22	7	21	4	69	11	62	17	46	18	63	0	33	0	103	0	11
23	7	53	4	118	11	16	16	16	16	16	0	45	0	45	0	45
25	0	122	4	2	11	02	20	02	20	02	0	02	0	02	0	02
26	0	81	4	115	11	81	20	115	20	50	0	81	0	81	0	33
27	0	82	4	114	11	80	20	114	20	52	0	82	0	82	0	59
28	0	13	4	88	11	34	18	63	20	11	0	13	0	13	0	13
29	7	25	4	8	11	08	20	08	20	08	0	08	0	08	0	08
30	0	80	4	48	11	35	20	48	20	54	0	80	0	80	0	32
31	7	24	4	5	11	05	20	05	20	05	0	05	0	05	0	05
33	7	29	4	1	11	01	20	01	20	01	0	01	0	01	0	01
34	7	28	4	59	11	90	20	59	17	33	0	117	0	117	0	117
35	0	85	4	42	11	88	20	52	17	32	0	85	0	85	0	17
36	0	35	4	40	11	127	17	63	16	38	0	35	0	35	0	35
37	7	27	4	7	11	07	20	07	20	07	0	07	0	07	0	07
38	7	127	4	54	11	45	20	54	20	108	0	15	0	15	0	15
39	7	26	4	4	11	04	20	04	20	04	0	04	0	04	0	04
41	7	00	4	17			16	64			7	00	0	90	7	00
42			4	16			16	70						95		
43	7	28	4	36	11	93	20	36	20	115	0	56	0	56	0	56
44	7	20	4	0	11	00	20	00	20	00	0	00	0	00	0	00
45			4	112			16	15	20	48	0	113		113		
46	7	39	4	70	11	92	20	15	20	114	0	34	0	34	0	34
47			4	12							7	58	7	58	7	58
49	7	67	4	43	11	27	16	38	16	27	0	60	0	60	0	60
50	7	19	4	15	11	46	17	12	20	63	0	17	0	88	0	88
51	7	18	4	107	11	43	20	107	20	36	0	63	0	63	0	63
52	7	70	4	75	11	24	17	33	16	24	0	41	0	41	0	41
53	7	55	4	67	11	25	17	30	16	25	0	122	0	122	0	30
54	7	31	4	68	11	63	17	32	21	63	0	32	0	102	0	10
55	7	32	4	111	11	17	16	17	16	17	0	46	0	46	0	46

Bit	Function
M0L to M5L	Command Bits 0 to 5
M6L	Field Bit When the field bit =1, the command codes 0 to 63 are used. When the flied bit code=0, command codes 64 to 127 are used.
M7L	Inhibit Code When the inhibit code=1, there is no transmission. When the inhibit code=0, the selected code word is transmitted.
M0H to M4H	System Bits 0 to 4
M5H to M7H	Bank Select Bits When a Multi-System is selected, the bank select bits are stored in BS0 to BS2. M5H to M7H are no relevant when a Single System is selected.

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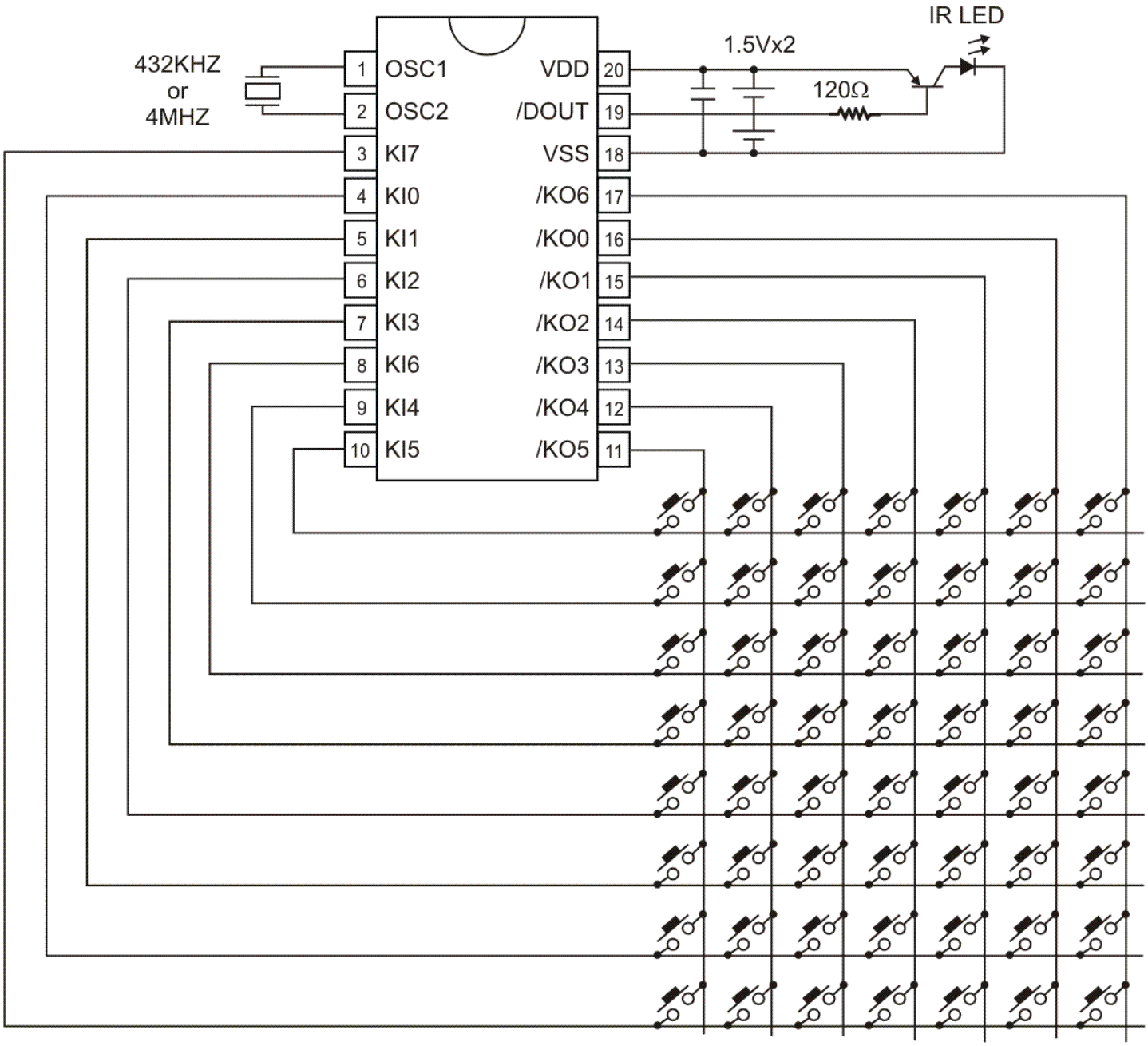
ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating	Unit
Operating voltage	Topr	-40 to +85	℃
Storage temperature	Tstg	-65 to +150	℃

ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Operating supply voltage	V_{DD}	-	2.0	-	5.5	V
Supply current	I_{DD}	V_{DD}=5V, Ta=25℃	-	-	2	mA
Standby current	$I_{DD(q)}$	V_{DD}=3V, Ta=25℃	-	-	1	μA
Sense Lines (Input only and will have a Weak Internal Pull-up Resistance)						
Low level input voltage	V_{IL}	-	-	-	$0.3V_{DD}$	V
High level input voltage	V_{IH}	-	$0.7V_{DD}$	-	-	V
Pull-up resistance	Rpu	V_{DD}=2V	50	-	100	KΩ
Driver Lines (Output only, Open-drain, maximum on-resistance when Low)						
Maximum on-resistance	Ron	V_{DD}=2V	-	-	2	KΩ
Output Driver (has weak pull-up resistance)						
Sink current	Isink	V_{DD}=2V, V_O=1V	-	-	45	mA
Pull-up resistance	Rpu	V_{DD}=2V	-	-	5	KΩ

APPLICATION CIRCUIT



Note: External capacitors must be connected to generate the 432KHz Oscillation Frequency.

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ORDER INFORMATION

Valid Part Number	Package Type	Top Code
PT2215-040	20 Pins, SOP, 300mil	PT2215-040

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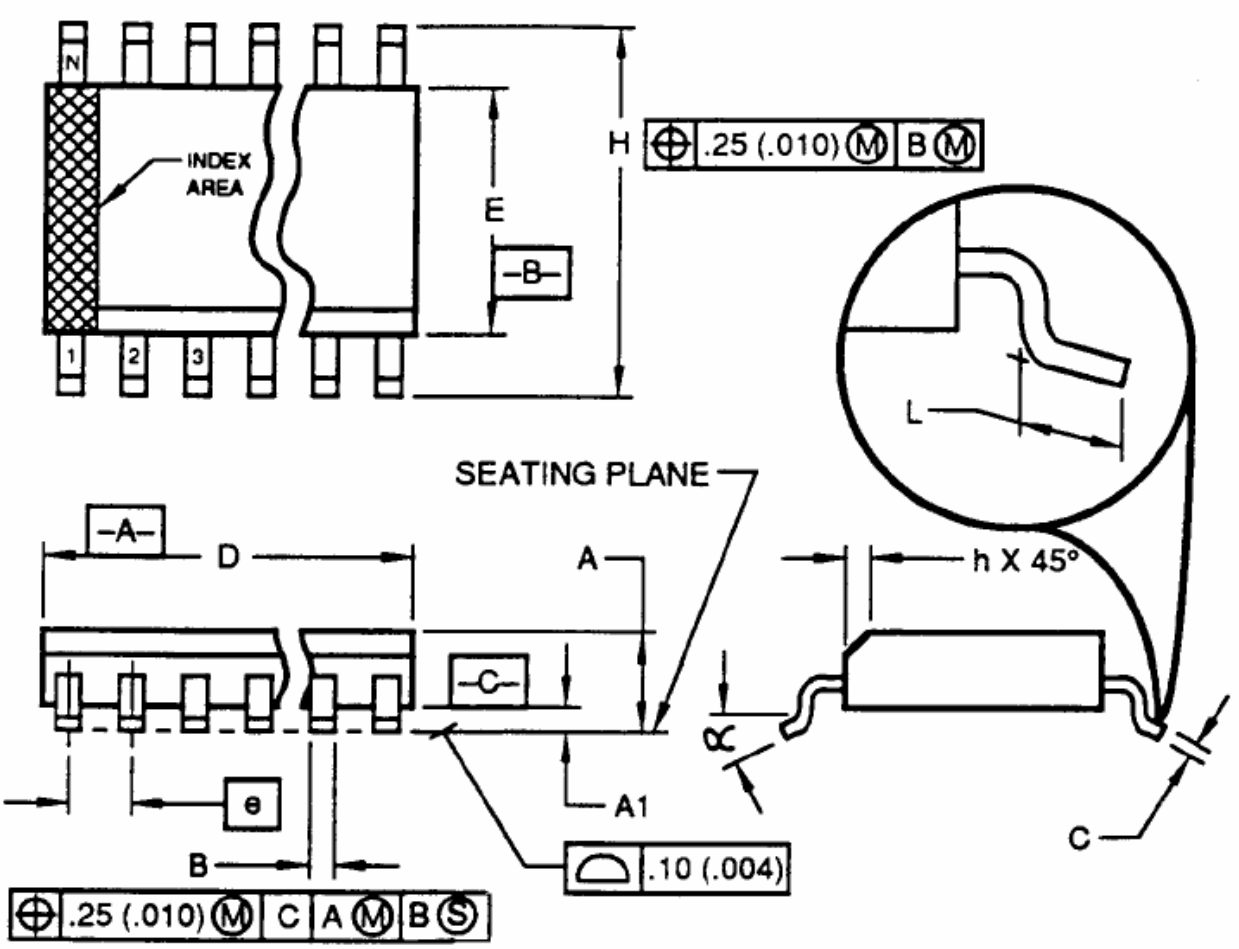
PACKAGE INFORMATION

20 PINS, SOP, 300MIL



Symbol	Dimensions In Millimeter		
	Min.	Nom.	Max.
A	2.35		2.65
A1	0.10		0.30
B	0.33		0.51
C	0.23		0.32
D	12.60		13.00
E	7.40		7.60
e		1.27 bsc.	
H	10.00		10.65
h	0.25		0.75
L	0.40		1.27
α	0°		8°

Notes:
1. Dimensioning and tolerancing per ANSI Y14.5M-1982.
2. Dimension “D” does not include mold flash, protrusions or gate burrs. Mold Flash, protrusion or gate burrs shall not exceed 0.15mm (0.006 in) per side.
3. Dimension “E” does not include interlead flash or protrusions. Interlead flash or protrusions shall not exceed 0.25mm (0.010 in) per side.
4. The chamfer on the body is optional. It is not present, a visual index feature must be located within the crosshatched area.
5. “L” is the length of the terminal for soldering to a substrate.
6. N is the number of the terminal positions (N=20)
7. The lead width “B” as measured 0.36mm (0.014 in) or greater above the seating plane, shall not exceed a maximum value of 0.61mm (0.24 in).
8. Controlling dimension: MILLIMETER.
9. Refer to JEDEC MS-013, Variation AC.

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