

## **Technical Description**

**The brief circuit description is listed as below:**

- 1) U1 acts as MCU (GPL32612B).**
- 2) U2 acts as Nand Rom (H27U518S2CTR-BC).**
- 3) U3 acts as RFID Reader (HL5233).**
- 4) U4 acts as Voltage regulator.**
- 5) Y1 act as 12MHz Crystal Oscillator.**
- 6) Y2 acts as 32.768kHz Crystal Oscillator.**
- 7) Y3 acts as 13.560MHz Crystal Oscillator.**
- 8) U7 acts as EEPROM**
- 9) SW1~SW8 act as control key buttons**

**Antenna Type: Internal integral antenna**

**Antenna Gain: 0dBi**

**Nominal field strength: 71.1dB $\mu$ V/m at 3m**

**Maximum allowed field strength of production tolerance: +/-3dB**



# HL5233

## HF RFID Reader IC

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### Features

- Low standby current.
- Low power consumption.
- Simple application circuit.
- Stable performance.
- The system and oscillator can be enable separately.
- 3 kinds of decoder outputs.
- Level hold mode and one-shot trigger mode.
- High active and low active output selectable.

### Applications

&lt;Patent : US6731177B2&gt;

- Toy RFID.
- Asset control.
- Contactless entry control.
- Education.

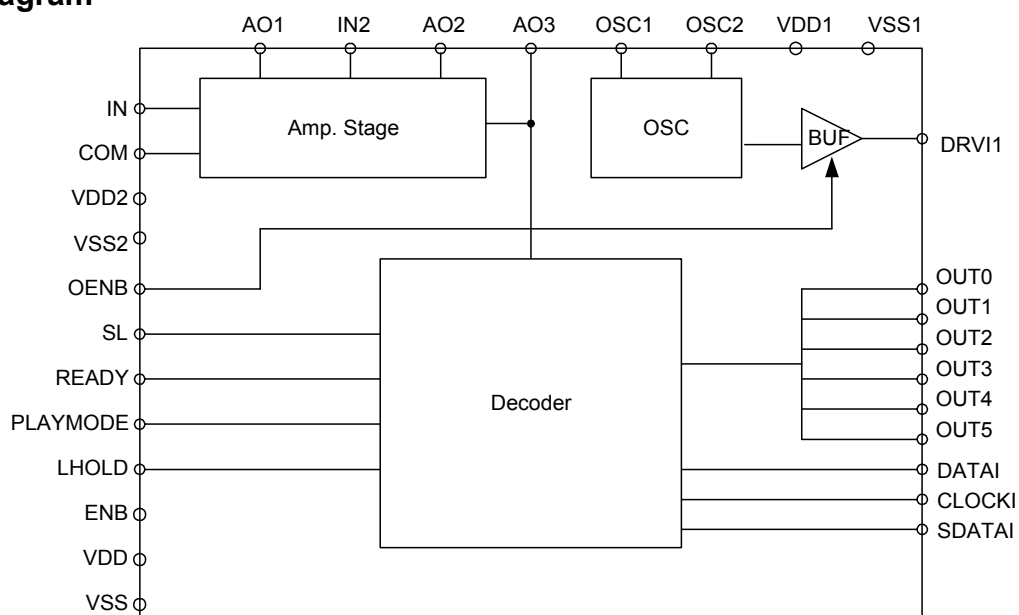
### General Description

HL5233 is a CMOS IC used to perform the function of a RFID Reader. A RFID contains two parts: RFID TAG (HL5230) and RFID Reader (HL5233). HL5233 contains of a 13.56MHz crystal oscillator, a 13.56MHz output buffer, a preamplifier and data decoder. The output buffer drives an antenna which can transmits RF signal to the RFID TAG.

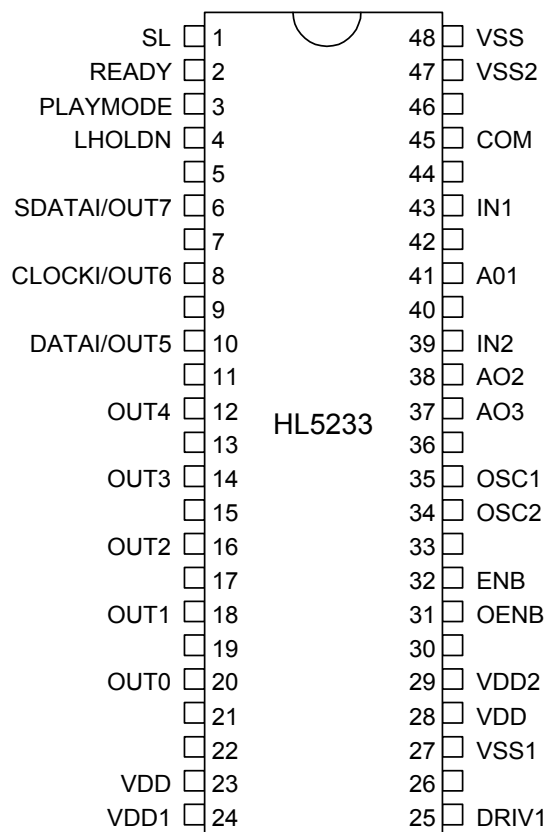
If TAG is close enough to the Reader, the encoder of TAG will send out a data train. The data train is used to modulate the RF signal in the TAG, and the amplitude of RF signal in the Reader will be modulated also. Preamplifier is used to amplify the modulating signal. The decoder is used to decoder the encoded data transmitted from TAG.

There are three kinds of output data: Synchronous, Asynchronous and Direct drive outputs. In order to interface to most of power Speech IC, the data rate of the outputs is slower than the data rate of the RFID TAG.

### Block Diagram



## Pin Connection



**Pin Description**

| PIN NO. | PIN NAME  | DESCRIPTION                                                                                                                                                                                                                                            |
|---------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | SL        | Data Bit Rate Select Pin.<br>It is used to determine the bit rate received from TAG.<br>SL = 1, Bit rate = 8KHz; SL = 0, Bit rate = 4KHz                                                                                                               |
| 2       | READY     | Play Mode Select Pin.<br>When PLAYMODE pin is high, this pin is used as Output Polarity Control Pin.<br>When PLAYMODE pin is low this pin is used as Ready input pin. When READY = 0, output signal is not available.                                  |
| 3       | PLAYMODE  | Output DATA Mode Control Pin.<br>When PLAYMODE = 1, Out0 ~ Out4, DATAI, CLOCKI, and SDATAI is used as direct output pin. When PLAYMODE = 0, Out0 ~ Out4 is also used as direct output, but DATAI, CLOCKI and SDATAI is used as serial data output pin. |
| 4       | LHOLDN    | Level-Hold Control Pin.<br>When LHOLDN = 0, DATA will be sent out continuously or output will active as long as TAG is closed to Reader. When LHOLDN = 1, only one set of DATA will be sent out or output will active for a short time.                |
| 5       | SDATAI    | Serial Data Output.<br>When PLAYMODE = 0, this pin is used as serial data output, i.e., DATA and CLOCK exist at same output. When PLAYMODE = 1, this pin is used as one of the direct output.                                                          |
| 6       | CLOCKI    | CLOCK Output.<br>When PLAYMODE = 0, this pin (combined with DATAI,) is used as synchronous DATA output pin. When PLAYMODE = 1, this pin is used as one of the direct output pins.                                                                      |
| 7       | DATAI     | DATA Output. ( As illustrated in CLOCKI )                                                                                                                                                                                                              |
| 8~12    | Out0~Out4 | Direct Output Pin.                                                                                                                                                                                                                                     |
| 13      | VDD       | Positive Power Supply Terminal.                                                                                                                                                                                                                        |
| 14      | VDD1      | Positive Power Supply Terminal.                                                                                                                                                                                                                        |
| 15      | DRIV1     | Coil Driver Output of 13.56MHz oscillator.                                                                                                                                                                                                             |
| 16      | VSS1      | Negative Power Supply Terminal.                                                                                                                                                                                                                        |
| 17      | VDD       | Positive Power Supply Terminal.                                                                                                                                                                                                                        |
| 18      | VDD2      | Positive Power Supply Terminal of Preamplifier.                                                                                                                                                                                                        |
| 19      | OENB      | Coil Driver Enable Pin.<br>When OENB = 0, coil driver will disable, others circuit still work. When OENB = 1, coil driver enable.                                                                                                                      |
| 20      | ENB       | Enable Input Pin of the whole system.                                                                                                                                                                                                                  |
| 21      | OSC2      | Oscillator Output Pin.                                                                                                                                                                                                                                 |
| 22      | OSC1      | Oscillator Input Pin.                                                                                                                                                                                                                                  |
| 23      | AO3       | Output Pin of 3 <sup>rd</sup> stage of Preamplifier.                                                                                                                                                                                                   |
| 24      | AO2       | Output Pin of 2 <sup>nd</sup> stage of Preamplifier.                                                                                                                                                                                                   |
| 25      | IN2       | Inverting Input Pin of 2 <sup>nd</sup> stage of Preamplifier.                                                                                                                                                                                          |
| 26      | AO1       | Output Pin of 1 <sup>st</sup> stage of Preamplifier.                                                                                                                                                                                                   |
| 27      | IN1       | Inverting Input Pin of 1 <sup>st</sup> stage of Preamplifier.                                                                                                                                                                                          |
| 28      | COM       | Common Input Pin of Preamplifier.                                                                                                                                                                                                                      |
| 29      | VSS2      | Negative Power Supply Terminal of Preamplifier.                                                                                                                                                                                                        |
| 30      | VSS       | Negative Power Supply Terminal.                                                                                                                                                                                                                        |

## Absolute Maximum Ratings

Power Supply ..... 5V  
 Input Voltage ..... VSS-0.3V to VDD+0.3V  
 Operating Temperature ..... 0 °C to 60 °C  
 Storage Temperature ..... -65 °C to 125 °C

## Electrical Characteristics

1.

| SYSTEM | DESCRIPTION                      | TEST CONDITION | LIMIT   |      |         | UNIT |
|--------|----------------------------------|----------------|---------|------|---------|------|
|        |                                  |                | MIN.    | TYP. | MAX.    |      |
| VDD    | Supply Voltage                   |                | 3       | 4.5  | 5       | V    |
| VIL    | Input Voltage Low                | VDD=4.5V       |         |      | 0.3*VDD | V    |
| VIH    | Input Voltage High               | VDD=4.5V       | 0.7*VDD |      |         | V    |
| VOSC   | Oscillator Starting Voltage      |                |         | 2.2  |         | V    |
| IOP1   | Operating Current 1              | VDD=4.5V       |         | 19*  |         | mA   |
| IOP2   | Operating Current 2 (Driver Off) | VDD=4.5V       |         | 1    |         | mA   |
| IST    | Stand-by Current                 | VDD=4.5V       |         | 0.5  |         | uA   |

\* IOP depends on external coil.

2.

| SYSTEM | DESCRIPTION                      | TEST CONDITION | LIMIT   |      |         | UNIT |
|--------|----------------------------------|----------------|---------|------|---------|------|
|        |                                  |                | MIN.    | TYP. | MAX.    |      |
| VDD    | Supply Voltage                   |                | 2.4     | 3    | 3.6     | V    |
| VIL    | Input Voltage Low                | VDD=3V         |         |      | 0.3*VDD | V    |
| VIH    | Input Voltage High               | VDD=3V         | 0.7*VDD |      |         | V    |
| VOSC   | Oscillator Starting Voltage      |                |         | 2.2  |         | V    |
| IOP1   | Operating Current 1              | VDD=3V         |         | 10*  |         | mA   |
| IOP2   | Operating Current 2 (Driver Off) | VDD=3V         |         | 0.7  |         | mA   |
| IST    | Stand-by Current                 | VDD=3V         |         | 0.5  |         | uA   |

\* IOP depends on external coil.

\* Test condition Temperature=25 °C.

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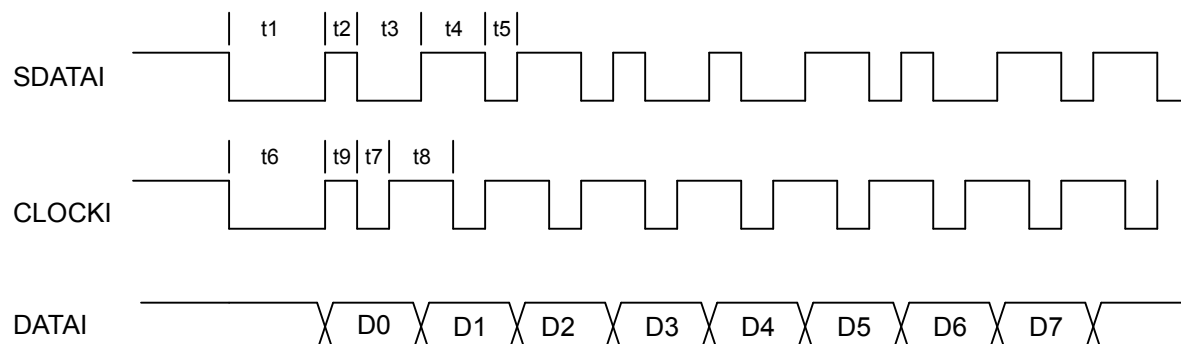
## Functional Description

There are three major function provided by HL5233: support a 13.56MHz driver, to transform DATA Bit rate for easy interface with MCU or power Speech IC and to provide direct decoder output.

After received the modulating signal from the RFID TAG, the modulating signal is amplified and filtered by preamplifier. There is decoder and error detector built in the HL5233. The decoded output can be sent to output pin directly, or encoded again at a slower bit rate. When PLAYMODE = 1, there are 8 direct output provided. Besides the 3 bits which is used as decoder inputs, there is 1 bit, which is used as parity check bit. The output will be activated only when parity is correct. In HL5233 even parity is used, Bit0~Bit2 is used as decoder input and Bit7 is parity Bit.

OENB is coil driver enable pin. When OENB=0, coil driver is off, while others circuit still work.

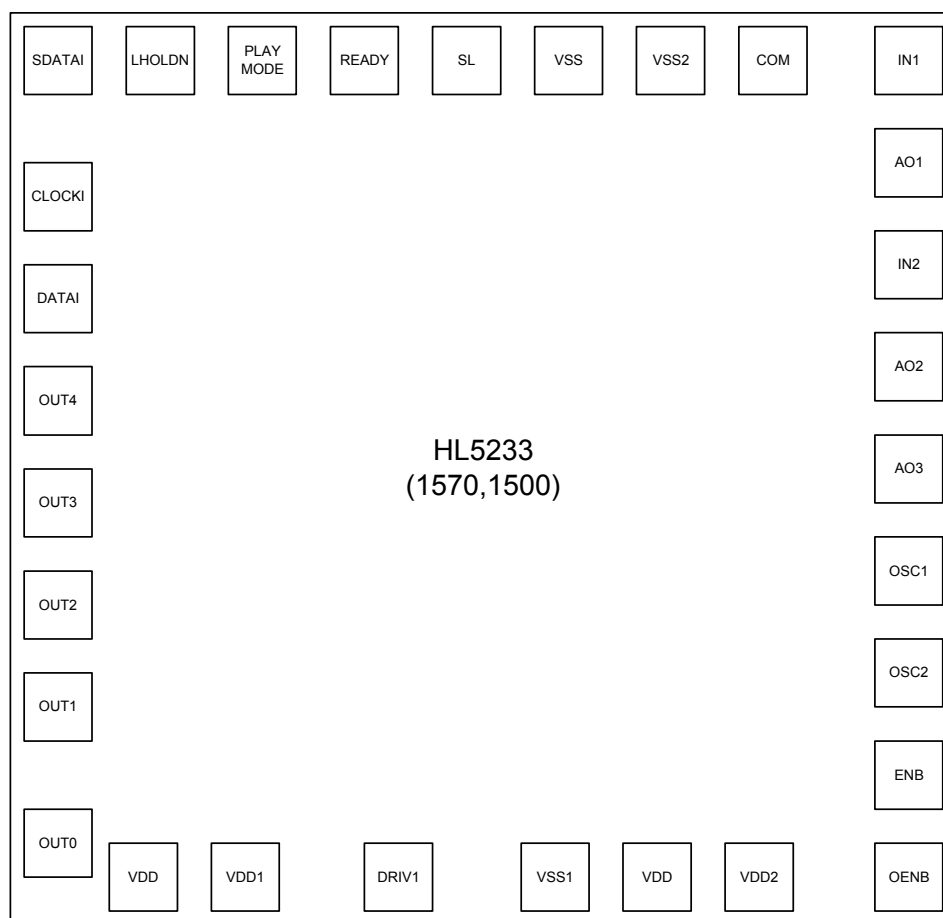
## Data I/O Format in Serial Mode



| SL = 0                     |   |         |                                       |
|----------------------------|---|---------|---------------------------------------|
| t1 ( Start )               | : | 2.84 ms | t6 ( Start ) : 2.84 ms                |
| t2 ( Data Low Front-end )  | : | 0.95 ms | t7 ( Clock Low Period ) : 0.95 ms     |
| t3 ( Data Low Back-end )   | : | 1.89 ms | t8 ( Clock High Back-end ) : 1.89 ms  |
| t4 ( Data High Front-end ) | : | 1.89 ms | t9 ( Clock High Front-end ) : 0.95 ms |
| t5 ( Data High Back-end )  | : | 0.95 ms |                                       |

| SL = 1                     |   |         |                                       |
|----------------------------|---|---------|---------------------------------------|
| t1 ( Start )               | : | 1.42 ms | t6 ( Start ) : 1.42 ms                |
| t2 ( Data Low Front-end )  | : | 0.47 ms | t7 ( Clock Low Period ) : 0.47 ms     |
| t3 ( Data Low Back-end )   | : | 0.95 ms | t8 ( Clock High Back-end ) : 0.95 ms  |
| t4 ( Data High Front-end ) | : | 0.95 ms | t9 ( Clock High Front-end ) : 0.47 ms |
| t5 ( Data High Back-end )  | : | 0.47 ms |                                       |

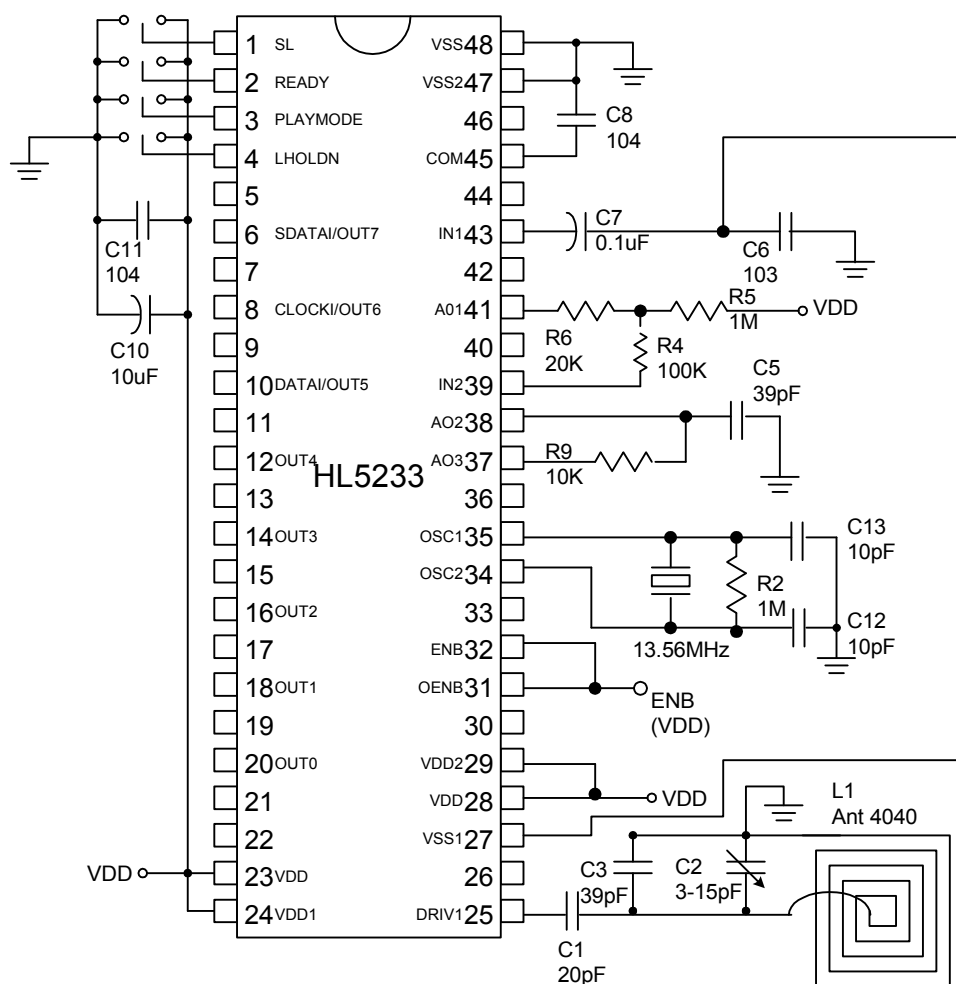
## Bonding Pad Diagram



Note: Substrate is connected to VSS.

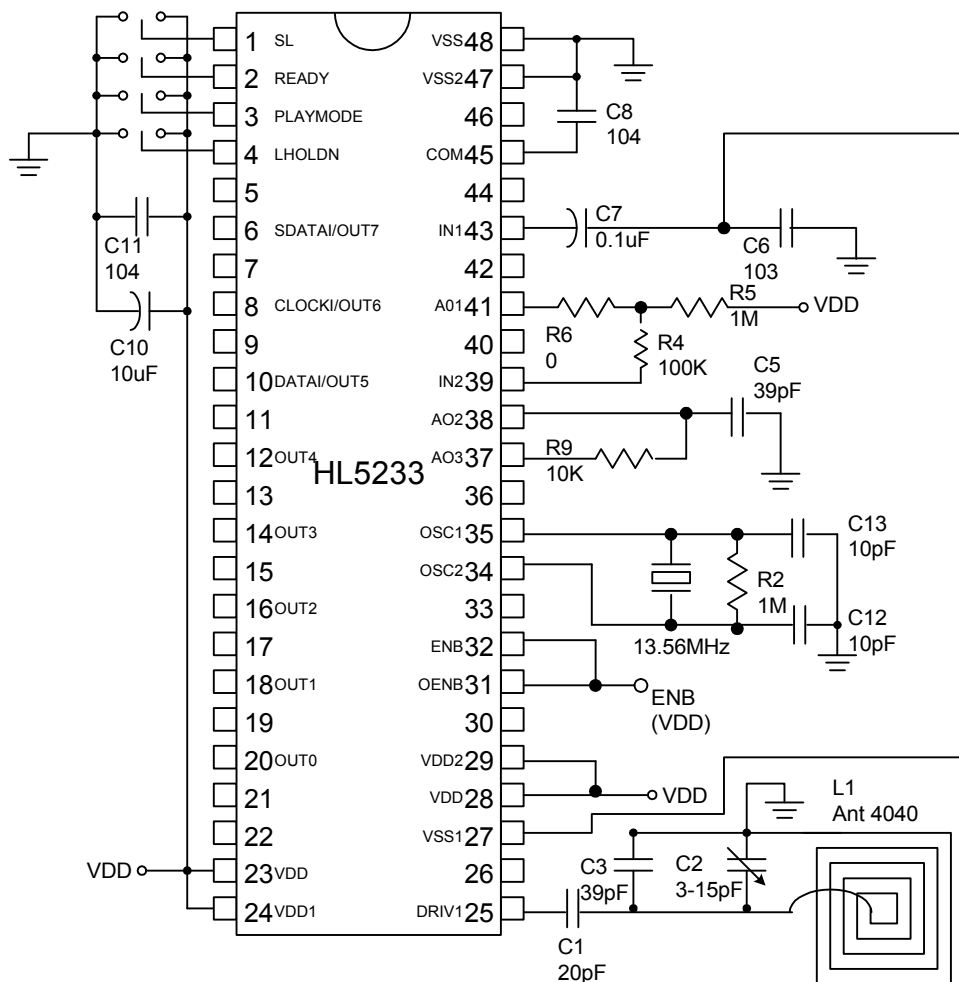
| PAD   | X, Y Unit: $\mu\text{m}$ | PAD   | X, Y Unit: $\mu\text{m}$ | PAD      | X, Y Unit: $\mu\text{m}$ |
|-------|--------------------------|-------|--------------------------|----------|--------------------------|
| VDD   | 278, 98                  | A03   | 1373, 703                | PLAYMODE | 428, 1303                |
| VDD1  | 428, 98                  | AO2   | 1373, 853                | LHOLDN   | 278, 1303                |
| DRIV1 | 662, 98                  | IN2   | 1373, 1003               | SDATAI   | 128, 1303                |
| VSS1  | 872, 98                  | AO1   | 1373, 1153               | SLOCKI   | 128, 1099                |
| VDD   | 1026, 98                 | IN1   | 1373, 1303               | DATAI    | 128, 946                 |
| VDD2  | 1176, 98                 | COM   | 1178, 1303               | OUT4     | 128, 796                 |
| OENB  | 1373, 98                 | VSS2  | 1028, 1303               | OUT3     | 128, 643                 |
| ENB   | 1373, 248                | VSS   | 878, 1303                | OUT2     | 128, 493                 |
| OSC2  | 1373, 403                | SL    | 728, 1303                | OUT1     | 128, 304                 |
| OSC1  | 1373, 553                | READY | 578, 1303                | OUT0     | 128, 138                 |

**Application Circuit**  
(Supply Voltage=4.5V)



※For best performance, the resonant capacitors(C1-C3) must be used of NPO(C0G) type and under +/-2% tolerance; And all PCB's antenna boards are used of FR-4 or compliant.

(Supply Voltage=3V)



※For best performance, the resonant capacitors(C1-C3) must be used of NPO(C0G) type and under +/-2% tolerance; And all PCB's antenna boards are used of FR-4 or compliant.

Sino Matrix Technology does not assume any responsibility for use of any circuitry described and Sino Matrix Technology reserves the right to change the circuitry and specifications without notice at any time.

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