

## OVERVIEW

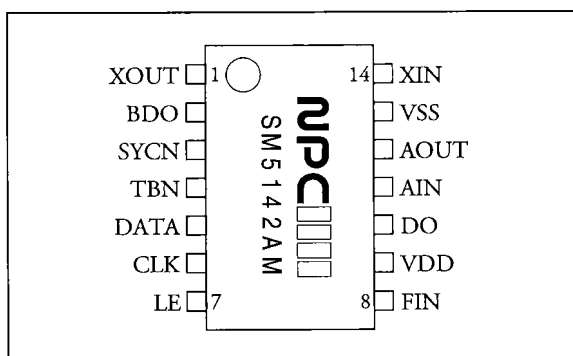
The SM5142AP/AM is a 20 MHz frequency synthesizer PLL IC, fabricated using NPC's unique Molybdenum-gate CMOS process. It is ideal for tuners that use double-conversion receivers.

## FEATURES

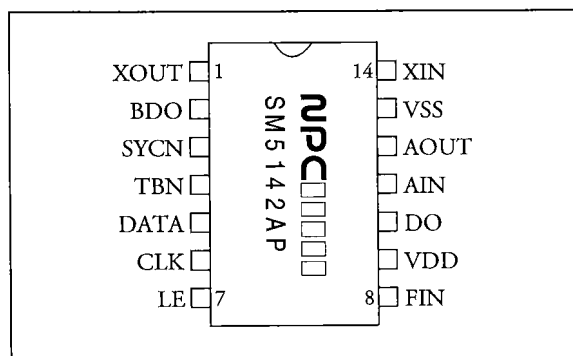
- 20 MHz direct frequency division
- 4 selectable reference frequencies (1, 5, 9 and 10 kHz)
- Built-in transistor for low-pass filter
- 60 kHz and 8 Hz outputs for external application
- Package
  - 14-pin plastic SSOP
  - 14-pin plastic DIP
- Molybdenum-gate CMOS process

## PINOUTS

### 14-pin SSOP



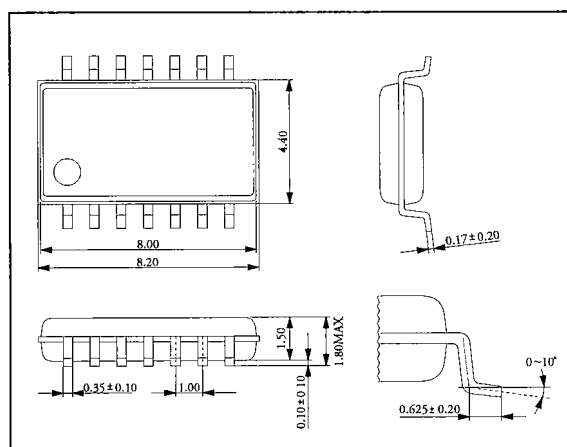
### 14-pin DIP



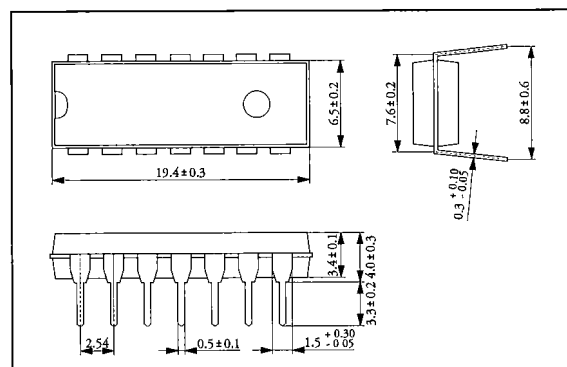
## PACKAGE DIMENSIONS

Unit: mm

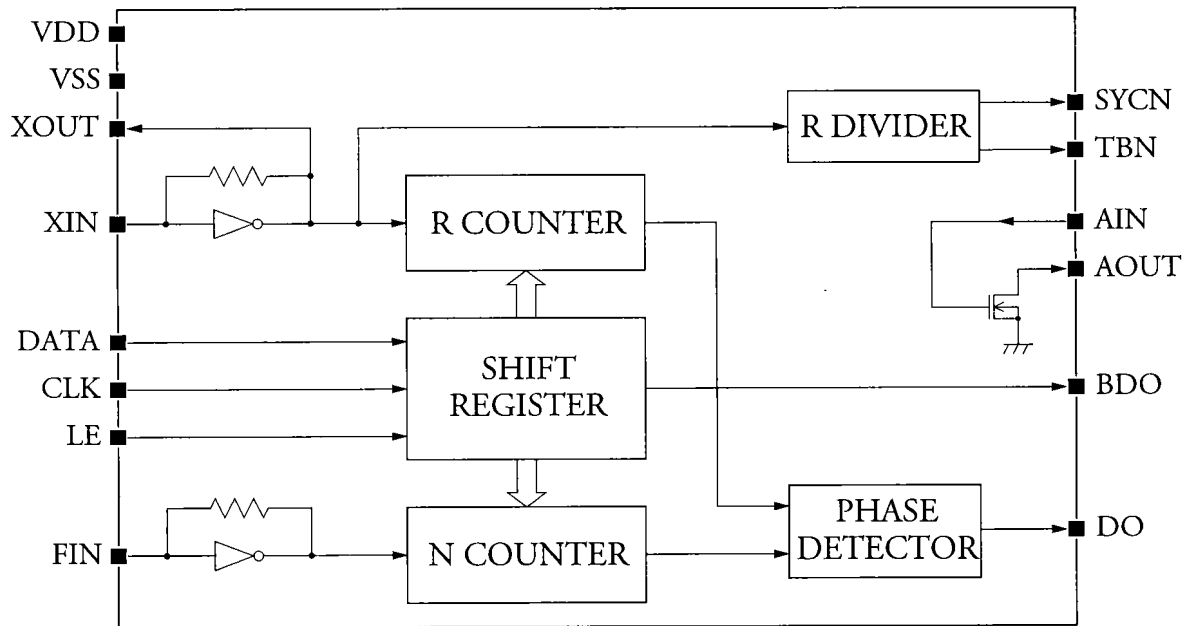
### SM5142AM (14-pin SSOP)



### SM5142AP (14-pin DIP)



## BLOCK DIAGRAM



## PIN DESCRIPTION

| Number | Name  | I/O | Description                                                                                                                                                                                      |
|--------|-------|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | XOUT  | O   | Crystal oscillator element and capacitor connection pin.<br>The signal from this pin can be input to a 2nd mixer stage.                                                                          |
| 2      | BDO   | O   | Shift register output pin                                                                                                                                                                        |
| 3      | SYNCN | O   | 60 kHz controller clock output pin.<br>N-channel open-drain output. A diode is built-in for electrostatic breakdown protection, so the voltage on this pin should not exceed the supply voltage. |
| 4      | TBN   | O   | 8 Hz time-base clock output pin.<br>N-channel open-drain output. A diode is built-in for electrostatic breakdown protection, so the voltage on this pin should not exceed the supply voltage.    |
| 5      | DATA  | I   | Shift register data input pin                                                                                                                                                                    |
| 6      | CLK   | I   | Clock input pin                                                                                                                                                                                  |
| 7      | LE    | I   | Latch write enable signal input pin                                                                                                                                                              |
| 8      | FIN   | I   | Programmable divider input pin.<br>A feedback resistor is built-in, and inputs can be coupled capacitively.                                                                                      |
| 9      | VDD   | —   | 4.5 to 5.5 V supply pin                                                                                                                                                                          |
| 10     | DO    | O   | Phase comparator output pin.<br>An active filter charge pump circuit is built-in.                                                                                                                |
| 11     | AIN   | I   | Low-pass filter amplifier input pin                                                                                                                                                              |
| 12     | AOUT  | O   | Low-pass filter amplifier output pin.<br>N-channel open-drain output.                                                                                                                            |
| 13     | VSS   | —   | Ground pin                                                                                                                                                                                       |
| 14     | XIN   | I   | Crystal oscillator element and capacitor connection pin.<br>Feedback resistor built-in.                                                                                                          |

## SPECIFICATIONS

### Absolute Maximum Ratings

 $V_{SS} = 0\text{ V}$ 

| Parameter                   | Symbol    | Condition                           | Rating                 | Unit             |
|-----------------------------|-----------|-------------------------------------|------------------------|------------------|
| Supply voltage range        | $V_{DD}$  |                                     | -0.3 to 6.5            | V                |
| Input voltage range         | $V_{IN}$  |                                     | -0.3 to $V_{DD} + 0.3$ | V                |
| AOUT output current range   | $I_{OUT}$ |                                     | 0 to 5.0               | mA               |
| AOUT output voltage range   | $V_{OUT}$ |                                     | -0.3 to 15.0           | V                |
| Power dissipation           | $P_D$     | $T_a \leq 85\text{ }^\circ\text{C}$ | 150                    | mW               |
| Operating temperature range | $T_{opr}$ |                                     | -30 to 85              | $^\circ\text{C}$ |
| Storage temperature range   | $T_{stg}$ |                                     | -55 to 125             | $^\circ\text{C}$ |
| Soldering temperature       | $T_{skd}$ |                                     | 255                    | $^\circ\text{C}$ |
| Soldering time              | $t_{skd}$ |                                     | 10                     | s                |

### Electrical Characteristics

 $V_{SS} = 0\text{ V}$ ,  $T_a = -30\text{ to }85\text{ }^\circ\text{C}$ 

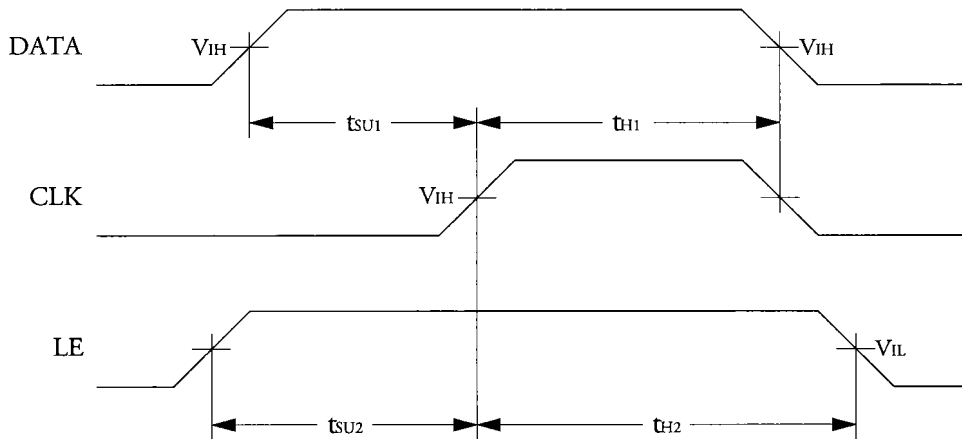
| Parameter                                     | Symbol               | Condition                    | Rating         |     |          | Unit          |
|-----------------------------------------------|----------------------|------------------------------|----------------|-----|----------|---------------|
|                                               |                      |                              | min            | typ | max      |               |
| Supply voltage                                | $V_{DD}$             |                              | 4.5            | -   | 5.5      | V             |
| Current consumption <sup>1</sup>              | $I_{DD1}$            |                              | -              | -   | 12       | mA            |
| Standby mode current consumption <sup>2</sup> | $I_{DD2}$            |                              | -              | 2   | 5        | mA            |
| FIN maximum operating frequency               | $f_{MAX1}$           |                              | 20             | -   | -        | MHz           |
| FIN minimum operating input amplitude         | $V_{IN1\text{ MIN}}$ | $f_{FIN} = 20\text{ MHz}$    | 100            | -   | -        | mVrms         |
| FIN minimum operating frequency               | $f_{MIN1}$           | $V_{FIN} = 100\text{ mVrms}$ | -              | -   | 5        | MHz           |
| XIN maximum operating frequency               | $f_{MAX2}$           | Crystal oscillator           | 12             | -   | -        | MHz           |
| FIN HIGH-level input current                  | $I_{IH1}$            | $V_{IH} = V_{DD}$            | -              | -   | 40       | $\mu\text{A}$ |
| FIN LOW-level input current                   | $I_{IL1}$            | $V_{IL} = V_{SS}$            | -              | -   | 40       | $\mu\text{A}$ |
| XIN HIGH-level input current                  | $I_{IH2}$            | $V_{IH} = V_{DD}$            | -              | -   | 20       | $\mu\text{A}$ |
| XIN LOW-level input current                   | $I_{IL2}$            | $V_{IL} = V_{SS}$            | -              | -   | 20       | $\mu\text{A}$ |
| CLK, DATA and LE HIGH-level input voltage     | $V_{IH}$             |                              | 2.0            | -   | $V_{DD}$ | V             |
| CLK, DATA and LE LOW-level input voltage      | $V_{IL}$             |                              | 0              | -   | 0.5      | V             |
| AOUT output voltage                           | $V_{OUT1}$           |                              | -              | -   | 13       | V             |
| Output voltage (all pins except AOUT)         | $V_{OUT2}$           |                              | -              | -   | $V_{DD}$ | V             |
| DO HIGH-level output voltage                  | $V_{OH1}$            | $I_{OH} = 0.5\text{ mA}$     | $V_{DD} - 1.0$ | -   | -        | V             |
| DO LOW-level output voltage                   | $V_{OL1}$            | $I_{OL} = 0.5\text{ mA}$     | -              | -   | 1.0      | V             |
| SYCN and TBN LOW-level output voltage         | $V_{OL2}$            | $I_{OL} = 0.5\text{ mA}$     | -              | -   | 1.0      | V             |
| BDO HIGH-level output voltage                 | $V_{OH3}$            | $I_{OH} = 1.0\text{ mA}$     | $V_{DD} - 1.0$ | -   | -        | V             |
| BDO LOW-level output voltage                  | $V_{OL3}$            | $I_{OL} = 1.0\text{ mA}$     | -              | -   | 1.0      | V             |
| AOUT LOW-level output voltage                 | $V_{OL4}$            | $I_{OL} = 1.0\text{ mA}$     | -              | -   | 1.0      | V             |

# SM5142AP/AM

| Parameter                            | Symbol   | Condition         | Rating |     |     | Unit    |
|--------------------------------------|----------|-------------------|--------|-----|-----|---------|
|                                      |          |                   | min    | typ | max |         |
| DO HIGH-level output leakage current | $I_{IH}$ | $V_{OH} = V_{DD}$ | —      | —   | 0.1 | $\mu A$ |
| DO LOW-level output leakage current  | $I_{IL}$ | $V_{OL} = V_{SS}$ | —      | —   | 0.1 | $\mu A$ |

1.  $f_{FIN} = 20$  MHz (100 mVrms), 11.16 MHz crystal between XIN and XOUT, all other inputs =  $V_{SS}$ , all outputs open.
2. 11.16 MHz crystal between XIN and XOUT, all other inputs =  $V_{SS}$ , all outputs open.

## Input timing characteristics



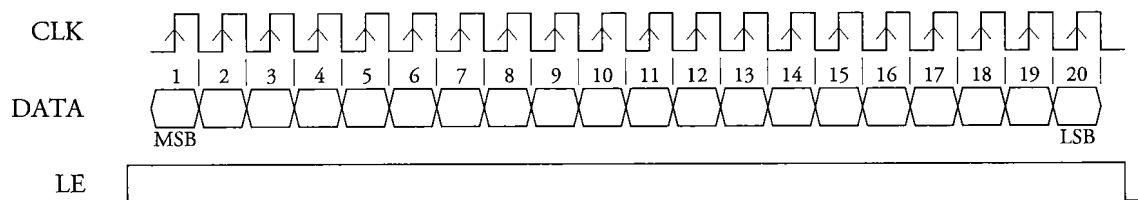
| Parameter       | Symbol    | Rating <sup>1</sup> | Unit    |
|-----------------|-----------|---------------------|---------|
| DATA setup time | $t_{SU1}$ | $\geq 12$           | $\mu s$ |
| LE setup time   | $t_{SU2}$ | $\geq 12$           | $\mu s$ |
| DATA hold time  | $t_{H1}$  | $\geq 12$           | $\mu s$ |
| LE hold time    | $t_{H2}$  | $\geq 12$           | $\mu s$ |

1. 11.16 MHz crystal oscillator element. For other crystal oscillator frequencies, multiply the rating shown by  $(124/f_{Xtal})$ .

## FUNCTIONAL DESCRIPTION

### Input Data

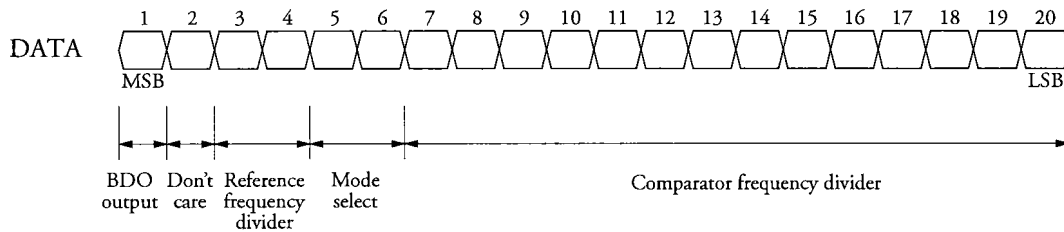
#### Data input timing



The 20-bit data is input on DATA with the MSB first.  
The data is input to the shift register on the rising edge of CLK. Accordingly, data changes should occur on the falling edge of CLK.

## Data settings

The comparator frequency, reference frequency and all other parameters can be set by the 20-bit input data. The 20-bit data has the following structure.



Bit 1 sets the BDO output. BDO is HIGH when this bit is 1. BDO is LOW when this bit is 0.

Bit 2 is not used and has no meaning. It can be set to any state.

Bits 3 and 4 select the reference frequency divider as shown in the following table.

| Bit 3 | Bit 4 | Comparator frequency <sup>1</sup> | Frequency divider ratio |
|-------|-------|-----------------------------------|-------------------------|
| 0     | 0     | 9 kHz                             | 1240                    |
| 1     | 0     | 10 kHz                            | 1116                    |
| 0     | 1     | 1 kHz                             | 11160                   |
| 1     | 1     | 5 kHz                             | 2232                    |

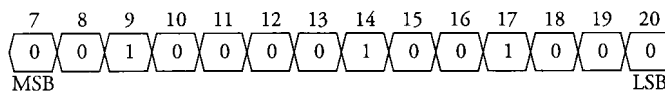
1. 11.16 MHz crystal oscillator

Bits 5 and 6 select the PLL operating mode as shown in the following table.

|                           | Bit 5 | Bit 6 | BDO                                                      | TBN  |
|---------------------------|-------|-------|----------------------------------------------------------|------|
| Normal mode               | 0     | 0     | Bit 1                                                    | 8 Hz |
| Standby mode <sup>1</sup> | 1     | 0     | Bit 1                                                    | 8 Hz |
| Test mode                 | 0     | 1     | This mode is for IC testing only and should not be used. |      |
|                           | 1     | 1     |                                                          |      |

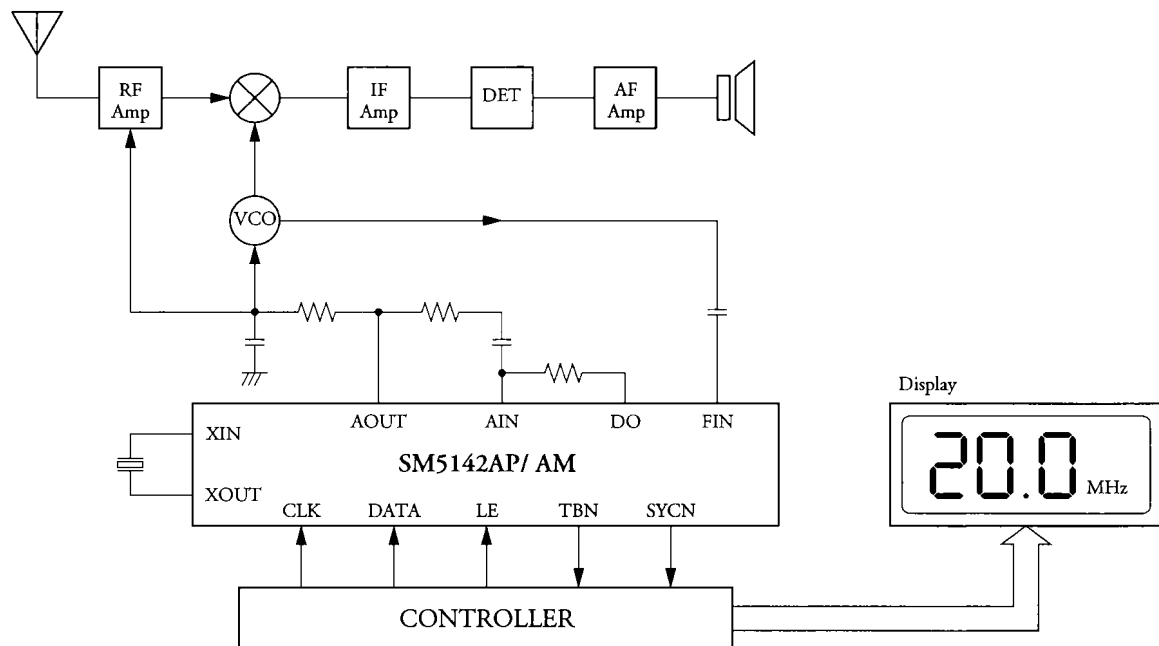
1. The feedback resistor is open circuit, so FIN goes HIGH and the N counter operation stops.

Bits 7 to 20 set the comparator frequency divider. Bit 7 is the MSB, and bit 20 is the LSB. An example is shown below.



↓  
2120

## TYPICAL APPLICATION



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