

**MOTOROLA  
 SEMICONDUCTOR  
 TECHNICAL DATA**

MOTOROLA SC (TELECOM)

**MC145030**

*Advance Information*  
**Remote Control Encoder/  
 Decoder  
 CMOS**

The MC145030 encodes and decodes nine bits of information, which allows 512 different codes.

The encoder section samples the 9-bit parallel address input, encodes the bits into Manchester Code, and sends the serial information via the ENC<sub>out</sub> pin. The address is issued twice per encoding sequence; initialization occurs with a rising edge on ENC ENB.

The decoder accepts serial information at the DEC<sub>in</sub> pin, and decodes the Manchester information. The decoded address is compared with the local address. If a match occurs, DEC<sub>out</sub> toggles once per sequence. The active-high DRST input is used to clear DEC<sub>out</sub>.

The Status pin, when high, indicates the device is encoding. During decoding or standby, Status is low.

- Applications:  
 Cordless Phones and Half-Duplex Remote Control
- Interfaces with RF, Ultrasonic, or Infrared Modulators and Demodulators
- Operating Temperature Range: - 40 to 85°C
- Operating Voltage Range: 2 to 6 V
- Standby Supply Current: 20 µA Maximum @ 2.0 V
- Operating Supply Current: 700 µA Maximum @ 2.5 V
- Address Inputs Have On-Chip Pull-Up Devices
- RC Oscillator, No Crystal Required
- On-Chip Amplifier in Decode Section
- Power-On Reset Forces DEC<sub>out</sub> Low and Initializes the Decoder and Encoder Sections
- See Application Notes AN1016 and AN1126 and Article Reprint AR255



P SUFFIX  
 PLASTIC DIP  
 CASE 738



DW SUFFIX  
 SOG  
 CASE 751D

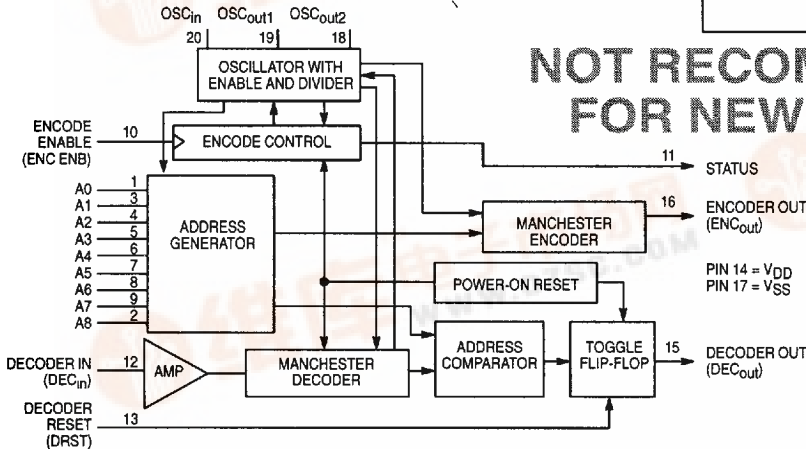
**ORDERING INFORMATION**

MC145030P Plastic DIP  
 MC145030DW SOG Package

**PIN ASSIGNMENT**

A0	1	20	OSC <sub>in</sub>
A8	2	19	OSC <sub>out1</sub>
A1	3	18	OSC <sub>out2</sub>
A2	4	17	V <sub>SS</sub>
A3	5	16	ENC <sub>out</sub>
A4	6	15	DEC <sub>out</sub>
A5	7	14	V <sub>DD</sub>
A6	8	13	DRST
A7	9	12	DEC <sub>in</sub>
ENC ENB	10	11	STATUS

**BLOCK DIAGRAM**



**NOT RECOMMENDED  
 FOR NEW DESIGN**

PIN 14 = V<sub>DD</sub>  
 PIN 17 = V<sub>SS</sub>

This document contains information on a new product. Specifications and information herein are subject to change without notice.

## MOTOROLA SC (TELECOM)

MAXIMUM RATINGS\* (Voltages Referenced to  $V_{SS}$ )

Symbol	Parameter	Value	Unit
$V_{DD}$	DC Supply Voltage	- 0.5 to + 7.0	V
$V_{in}$	DC Input Voltage	- 0.5 to $V_{DD} + 0.5$	V
$V_{out}$	DC Output Voltage	- 0.5 to $V_{DD} + 0.5$	V
$I_{in}$	DC Input Current, per Pin	± 10	mA
$I_{out}$	DC Output Current, per Pin	± 10	mA
$I_{DD}$	DC Supply Current, $V_{DD}$ and $V_{SS}$ Pins	± 30	mA
$P_D$	Power Dissipation, per Package†	500	mW
$T_{stg}$	Storage Temperature	- 65 to + 150	°C
$T_L$	Lead Temperature (10-Second Soldering)	260	°C

\* Maximum Ratings are those values beyond which damage to the device may occur. Functional operation should be restricted to the limits in the Electrical Characteristics tables or Pin Description section.

† Power Dissipation Temperature Derating: - 12 mW/°C from 65 to 85°C

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation,  $V_{in}$  and  $V_{out}$  should be constrained to the range  $V_{SS} \leq (V_{in} \text{ or } V_{out}) \leq V_{DD}$ .

Except for the Address Inputs, unused inputs must always be tied to an appropriate logic voltage level (e.g., either  $V_{SS}$  or  $V_{DD}$ ). The Address inputs may be left open; see Pin Descriptions. Unused outputs must be left open.

ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ , Voltages Referenced to  $V_{SS}$ )

Symbol	Parameter	Test Condition	$V_{DD}$ V	Guaranteed Limit	Unit
$V_{DD}$	Power Supply Voltage Range		—	2.0 to 6.0	V
$V_{IL}$	Maximum Low-Level Input Voltage (Except $DEC_{in}$ )		2.5 6.0	0.3 1.2	V
$V_{IH}$	Minimum High-Level Input Voltage (Except $DEC_{in}$ )		2.5 6.0	1.9 4.5	V
$V_{sig}$	Minimum Output Voltage of Signal Source Driving $DEC_{in}$	Square-Wave Source See Figure 1	2.5 6.0	200 200	mV <sub>p-p</sub>
$V_{OL}$	Maximum Low-Level Output Voltage	$I_{out} = 0 \mu\text{A}$ $I_{out} = 0.4 \text{ mA}$	2.5 6.0	0.15 0.4	V
$V_{OH}$	Minimum High-Level Output Voltage	$I_{out} = 0 \mu\text{A}$ $I_{out} = - 0.4 \text{ mA}$	2.5 6.0	2.35 2.0	V
$I_{in}$	Maximum Input Current $DEC_{in}$ ENC ENB, DRST, $OSC_{in}$	$V_{in} = V_{DD}$ or $V_{SS}$	6.0	± 60 ± 0.3	$\mu\text{A}$
$I_{IH}$	Maximum High-Level Input Leakage Current	$V_{in} = V_{DD}$ A0-A8	6.0	0.3	$\mu\text{A}$
$I_{IL}$	Maximum Low-Level Pull-Up Current	$V_{in} = V_{SS}$ A0-A8	6.0	- 100	$\mu\text{A}$
$I_{OZ}$	Maximum Three-State Leakage Current	$V_{out} = V_{DD}$ or $V_{SS}$ ENC <sub>out</sub>	6.0	± 500	nA
$I_{DD}$	Maximum Quiescent Supply Current	Device in Standby Mode $V_{in} = V_{SS}$ or $V_{DD}$ for ENC ENB, $DEC_{in}$ , DRST, $OSC_{in}$ $V_{in} = V_{SS}$ , $V_{DD}$ , or Open for A0-A8 $I_{out} = 0 \mu\text{A}$	2.0 6.0	20 100	$\mu\text{A}$
$I_{dd}$	Maximum RMS Operating Supply Current	Oscillator Frequency = 500 kHz $V_{in} = V_{SS}$ or $V_{DD}$ for ENC ENB, $DEC_{in}$ , DRST, $OSC_{in}$ $V_{in} = V_{SS}$ , $V_{DD}$ , or Open for A0-A8 $I_{out} = 0 \mu\text{A}$	2.5 6.0	700 2500	$\mu\text{A}$

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AC ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C, C<sub>L</sub> = 50 pF, V<sub>DD</sub> = 2.5 to 6 V unless otherwise stated)

Symbol	Parameter	Figure #	V <sub>DD</sub> V	Guaranteed Limit	Unit
f <sub>osc</sub>	Maximum Oscillator Frequency (= 50% Duty Cycle)*	2	—	500	kHz
t <sub>PLH</sub> , t <sub>PHL</sub>	System Propagation Delay, ENC ENB (of an encoding device) to DEC <sub>out</sub> (of a decoding device)	3, 5	—	384–608	OSC Cycles
t <sub>d</sub>	Debounce Time, ENC ENB (guarantees 1 encoding sequence)	—	—	608	OSC Cycles
t <sub>w</sub>	Minimum Input Pulse Width, ENC ENB or DRST	4	2.5 6.0	200 80	ns
C <sub>in</sub>	Maximum Input Capacitance	—	—	10	pF

\*See Pin Descriptions and Application Example for component tolerances.

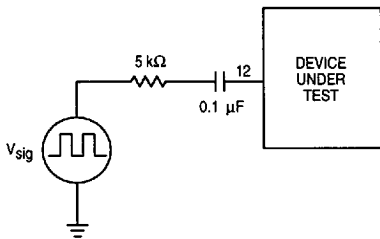


Figure 1. Decoder Input Sensitivity Test

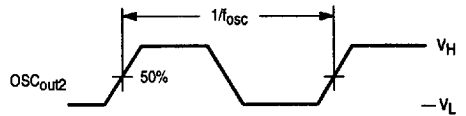


Figure 2. Switching Waveform

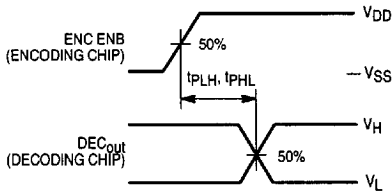


Figure 3. Switching Waveforms

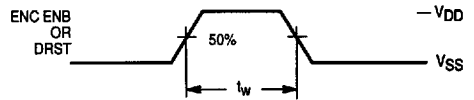
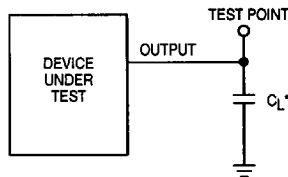


Figure 4. Switching Waveform



\*Includes all probe and fixture capacitance.

Figure 5. Test Circuit

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PIN DESCRIPTIONS

INPUT PINS

A0-A8

Local Address Inputs (Pins 1, 3-9, 2)

These binary inputs provide the address for both the encoder and decoder; 512 addresses are possible. The local address is sent serially from ENC<sub>Out</sub> with 2 sync bits appearing first, followed by A0. The decoder compares the local address with the received address stream.

On-chip pullup devices are provided on the address inputs to facilitate interface to SPST switches or jumpers to V<sub>SS</sub>. During standby, A0-A8 are in the high-impedance state (i.e., the pull-up devices are inactive to minimize standby power consumption).

The inputs are left open (or tied to V<sub>DD</sub>) for a high level and tied to V<sub>SS</sub> for a low level.

ENC ENB

Edge-Sensitive Encode Enable (Pin 10)

A low-to-high transition on this pin aborts any decoding sequence in progress and initiates an encoding sequence. This input is debounced 608 oscillator cycles. See Figures 8 and 9.

DEC<sub>in</sub>

Decoder In (Pin 12)

Decoder In is the input to the on-chip amplifier. The incoming signal is usually capacitively-coupled to this pin. Direct coupling may be used if the signal level is rail-to-rail (V<sub>SS</sub> to V<sub>DD</sub>).

DRST

Level-Sensitive Decoder Reset (Pin 13)

When this input is taken high, DEC<sub>out</sub> is cleared to a low level. This pin may be used to override a response from a DEC<sub>in</sub> data stream.

OUTPUT PINS

STATUS

Encode/Decode Status (Pin 11)

This pin is high during the encoding sequence and low during decoding or idle.

When Status is low, the ENC<sub>out</sub> pin is in the high-impedance state.

DEC<sub>out</sub>

Toggle Flip-Flop Decoder Output (Pin 15)

The encoder sends the same address twice to complete a sequence. If one or both of the decoded addresses matches the local address, DEC<sub>out</sub> toggles once per sequence (unless overridden by DRST). See Figures 6 and 7.

ENC<sub>out</sub>

Three-State Encoder Output (Pin 16)

This is the serial output of the Manchester-encoded local address. A0 appears before A8 in the bit stream. The local address is sent twice to complete a sequence which is initialized by ENC ENB. When a sequence is complete, ENC<sub>out</sub> returns to the high-impedance state. See Figures 8 and 9.

OSCILLATOR PINS

OSC<sub>in</sub>, OSC<sub>out1</sub>, OSC<sub>out2</sub>

Oscillator Input, Oscillator Outputs 1/2 (Pins 20, 19, 18)

As shown in Figure 10, these pins are used in conjunction with external resistors and a capacitor to form an oscillator. Polystyrene or mylar capacitors are recommended. Susceptibility to externally induced noise signals may occur if resistors utilized are greater than 1 MΩ. See Figure 10 for component tolerances.

When the on-chip oscillator is used, the frequency may be up to 500 kHz. The oscillator is active only during encoding or decoding.

When an external frequency source is used to drive OSC<sub>in</sub>, OSC<sub>out1</sub> and OSC<sub>out2</sub> may be left floating. The signal applied to OSC<sub>in</sub> should swing rail-to-rail and may be dc to 500 kHz.

POWER SUPPLY PINS

V<sub>SS</sub>

Negative Power Supply (Pin 17)

This pin is the negative supply potential and is usually ground.

V<sub>DD</sub>

Positive Power Supply (Pin 14)

This pin is the positive supply potential and may range from + 2 to + 6 V with respect to V<sub>SS</sub>.

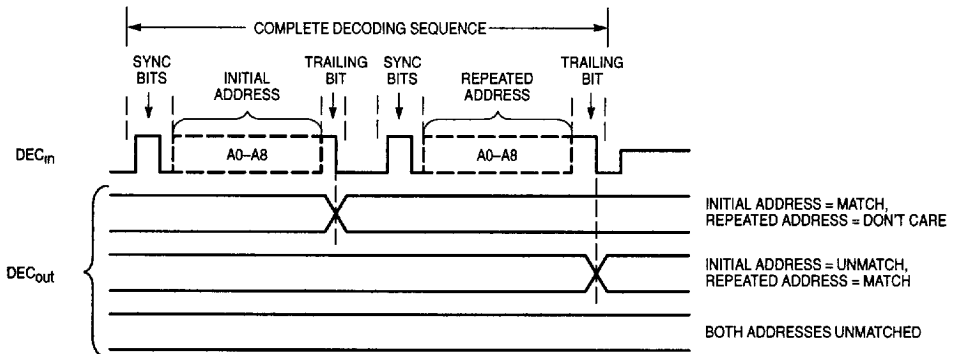


Figure 6. Decoder Timing Diagram

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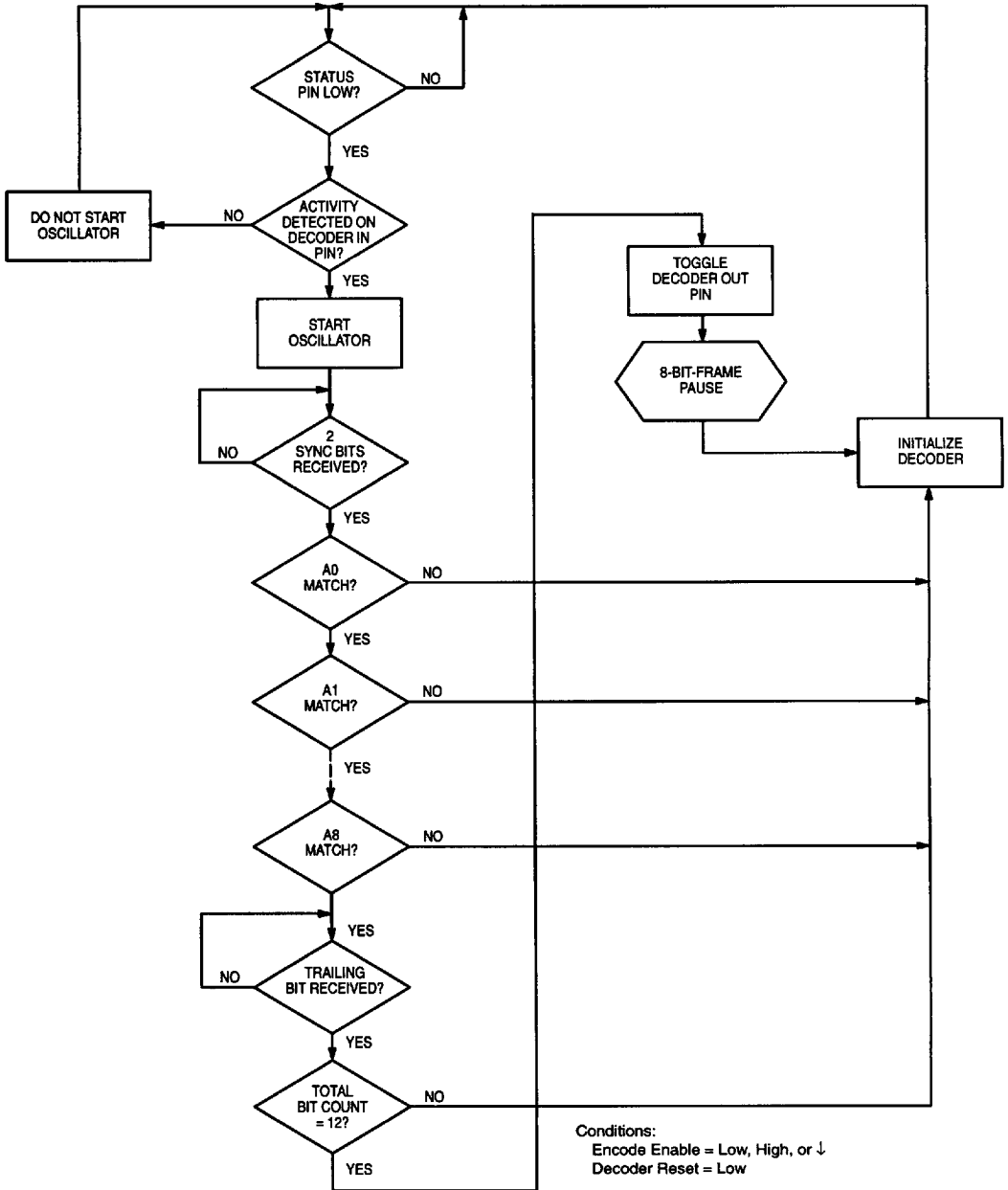


Figure 7. Decoder Flowchart

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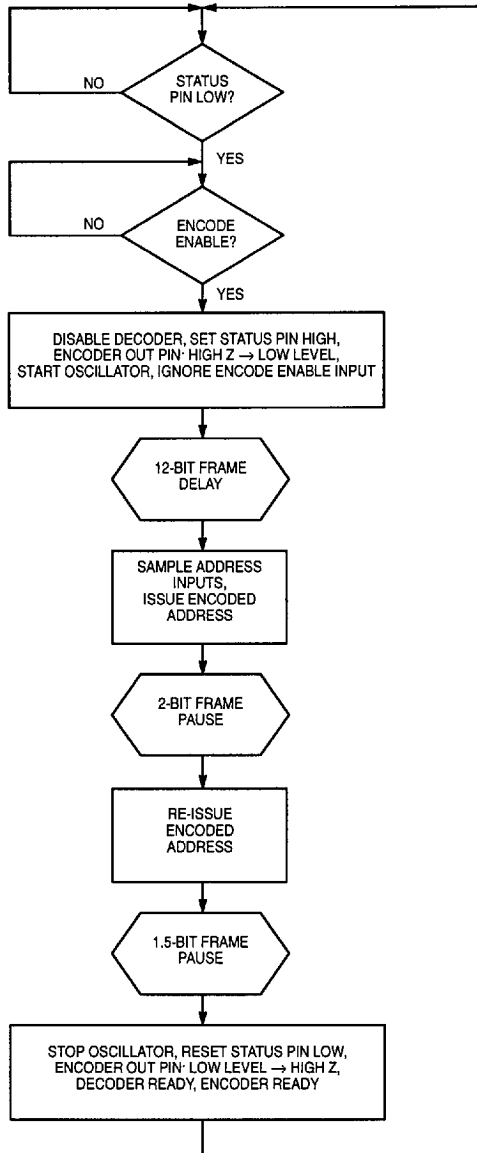


Figure 8. Encoder Flowchart

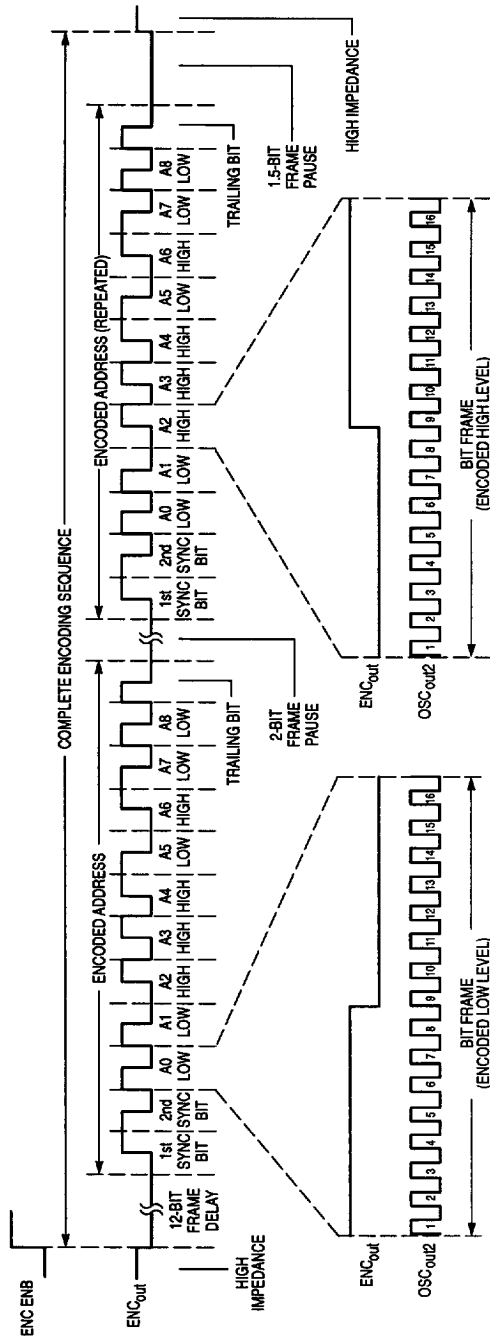
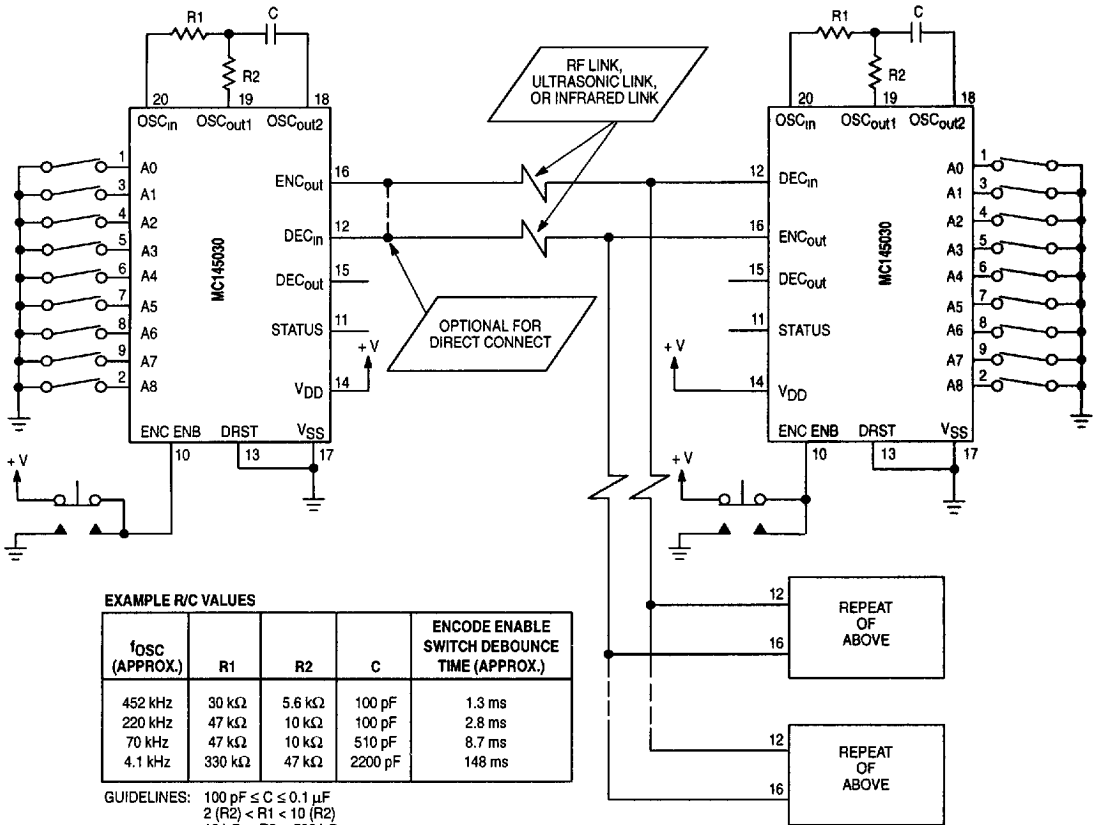


Figure 9. Encoder Timing Diagram

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EXAMPLE R/C VALUES

f <sub>osc</sub> (APPROX.)	R1	R2	C	ENCODE ENABLE SWITCH DEBOUNCE TIME (APPROX.)
452 kHz	30 kΩ	5.6 kΩ	100 pF	1.3 ms
220 kHz	47 kΩ	10 kΩ	100 pF	2.8 ms
70 kHz	47 kΩ	10 kΩ	510 pF	8.7 ms
4.1 kHz	330 kΩ	47 kΩ	2200 pF	148 ms

GUIDELINES: 100 pF ≤ C ≤ 0.1 μF  
 2 (R2) < R1 < 10 (R2)  
 10 kΩ ≤ R2 ≤ 500 kΩ  
 R1 ≤ 1 MΩ

The maximum oscillator frequency difference allowable from encoding IC to decoding IC is ± 11%. The ambient temperature and supply voltage differences between ICs affect this frequency difference. Therefore, the tolerances of the frequency-determining components R2 and C are determined by the rule of thumb:

$$[\Delta R2 + \Delta C + \Delta f_C + \Delta f_{temp} + \Delta f_{sup}] \leq \pm 11\%$$

where

R2 = tolerance of R2 in percent

C = tolerance of C in percent

f<sub>C</sub> = IC frequency variation from part to part (expected value: ± 4%)

f<sub>temp</sub> = IC frequency variation over temperature (expected value: ± 2% @ 25°C ± 40°)

f<sub>sup</sub> = IC frequency variation with supply (expected value: ± 2% @ 5 V ± 0.5 V)

For the above variances: [ΔR2 + ΔC + (± 4%) + (± 2%) + (± 2%)] ≤ ± 11%

$$[\Delta R2 + \Delta C] \leq \pm 3\%$$

Choose R2 with a ± 1% tolerance and C2 with a ± 2% tolerance. R1 may be ± 5%.

Figure 10. Application Example