HCS360

Code Hopping Encoder Product Brief*

FEATURES

Security

- Programmable 28/32-bit serial number
- Programmable 64-bit encryption key
- Each transmission is unique
- 67-bit transmission code length
- 32-bit hopping code
- 28-bit serial, 4-bit function, VLOW, 2-bit CRC
- 48-bit seed
- Encryption keys are read protected

Operating

- 2.0V to 6.0V range
- Four button inputs
  - No additional circuitry required
  - 15 functions available
- Selectable baud rate
- Automatic power down after transmission
- Battery low signal transmitted to receiver
- Nonvolatile synchronization data
- IR modulation capability

Other

- Easy to use programming interface
- On-chip EEPROM
- On-chip oscillator and timing components
- On-chip reset circuit
- Button inputs have internal pulldown resistors
- Current limiting on $\overline{\text{LED}}$ output

Typical Applications

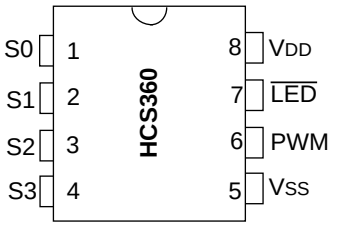
- Automotive remote entry systems
- Automotive alarm systems
- Automotive immobilizers
- Gate and garage door openers
- Electronic door locks
- Identity tokens
- Burglar alarm systems

GENERAL DESCRIPTION

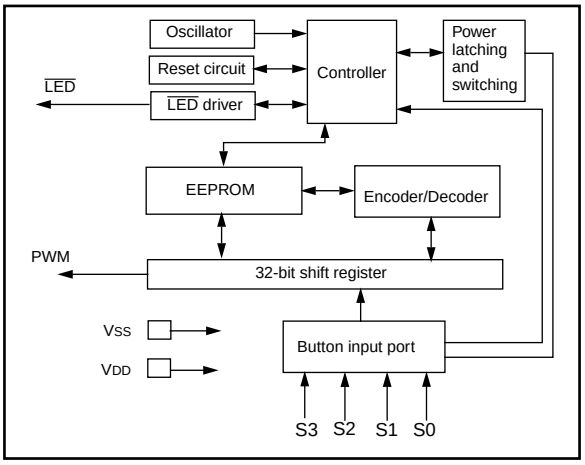
The Microchip Technology Inc. HCS360 is a code hopping encoder designed for OEM secure Remote Keyless Entry (RKE) systems. The HCS360 utilizes the patented KEELOQ® code hopping technology and features high security, a small package outline, low cost, and extended functionality to make this device a perfect solution for unidirectional RKE systems and access control systems.

PACKAGE TYPES

PDIP, SOIC



BLOCK DIAGRAM



The HCS360 combines a 32-bit hopping code with a selectable 28- or 32-bit serial number, four function bits, a VLOW bit and two error detection bits to create a 67-bit transmission stream. The length of the transmission eliminates the threat of code scanning and the code hopping mechanism makes each transmission unique, thus rendering code capture and resend (code–grabbing) schemes useless.

The encryption key, serial number and configuration data are stored in EEPROM which is not accessible via any external connection. This makes the HCS360 a very secure unit. The HCS360 provides an easy to use serial interface for programming the necessary security keys, system parameters and configuration data.

All encryption keys and code combinations are programmable but read-protected. The keys can only be verified after an automatic erase and programming operation. This protects against attempts to gain access to keys and manipulate synchronization values.

*Code hopping encoder patents allowed and pending.

KEELOQ is a registered trademark of Microchip Technology Inc.

The HCS360 operates over a wide voltage range of 2 volts to 6 volts and has four functional inputs in an 8-pin configuration. This gives the system designer the freedom to have up to 15 functions without adding any additional circuitry.

1.0 DEVICE OPERATION

1.1 Key Terms

- Manufacturer's key - a 64-bit word unique to each manufacturer used to produce a unique secret key in each encoder.
- Secret Key - a unique 64-bit key generated from the manufacturers key and the encoder serial number and used in the encryption.
- Learn - The ability of the decoder to learn information about an encoder so that future transmissions can be recognized and validated.
- Seed - Value that is transmitted when a certain combination of buttons is pressed during secure learn. Forms the seed for key generation.
- Discriminative Values - Check bits collated in the hopping code which can be verified once the code is decrypted.

As shown in Figure 1-1, the HCS360 is a simple device to use. It requires only the addition of buttons and RF circuitry for use as the transmitter in your security application. The high security level of the HCS360 is based on the KEELOQ patented technology. A block cipher based on a block length of 32 bits and a key length of 64 bits is used. The algorithm obscures the information in such a way that even if the transmission information (before coding) differs by only one bit from the information in the previous transmission, the next coded transmission will be totally different. Statistically, if only one bit in the 32-bit string of information changes, at least 50 percent of the coded transmission will change. As indicated in Figure 1-2, the HCS360 will wake up upon detecting a switch closure and then delay 6.5 ms for switch debounce. The switch information together with the synchronization information will be encrypted using the proprietary algorithm to create the encrypted portion of the transmission. The encrypted or code hopping portion of the transmission will change every time, even if the same button is pushed again. A code that has been transmitted will not occur again for more than 64K transmissions. This will provide more than 18 years of typical use before a code is repeated based on 10 operations per day. Overflow information sent from the encoder can be used by the decoder to extend the number of unique transmissions to more than 128K and to prevent the first 64K transmissions from ever occurring again.

1.2 Programming the HCS360

The HCS360 must be programmed before use. Programming the device is done using a simple serial interface using two of the pins on the HCS360 for clock and data. When the programming cycle is entered, all EEPROM values are erased and verification of the stored values is not possible until after the programming cycle is complete. These features prevent unauthorized access to and tampering of the stored values.

FIGURE 1-1: TYPICAL APPLICATION CIRCUIT

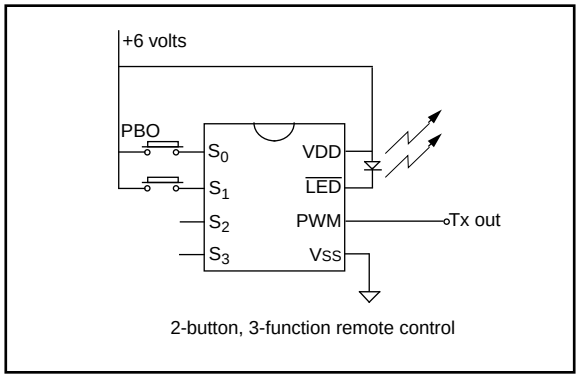


FIGURE 1-2: ENCODER OPERATION

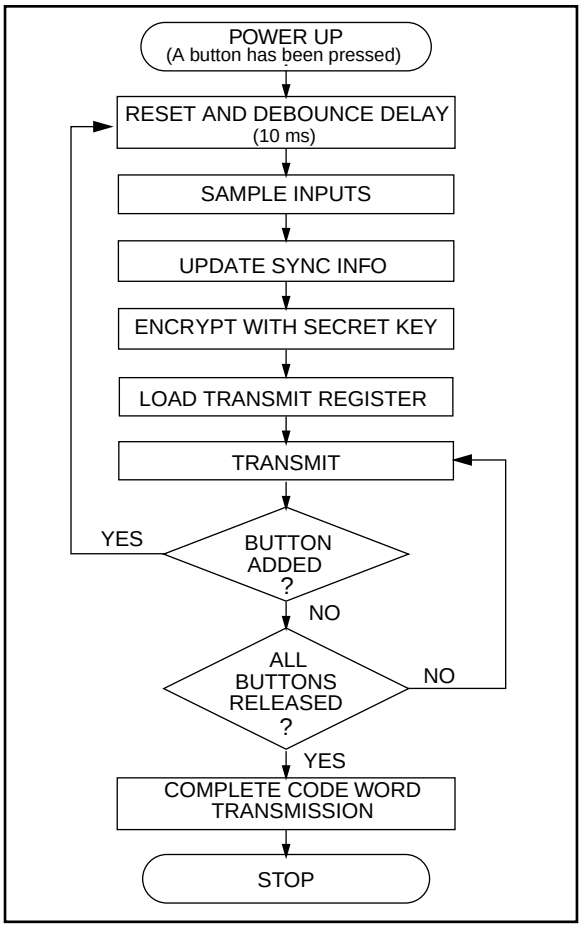
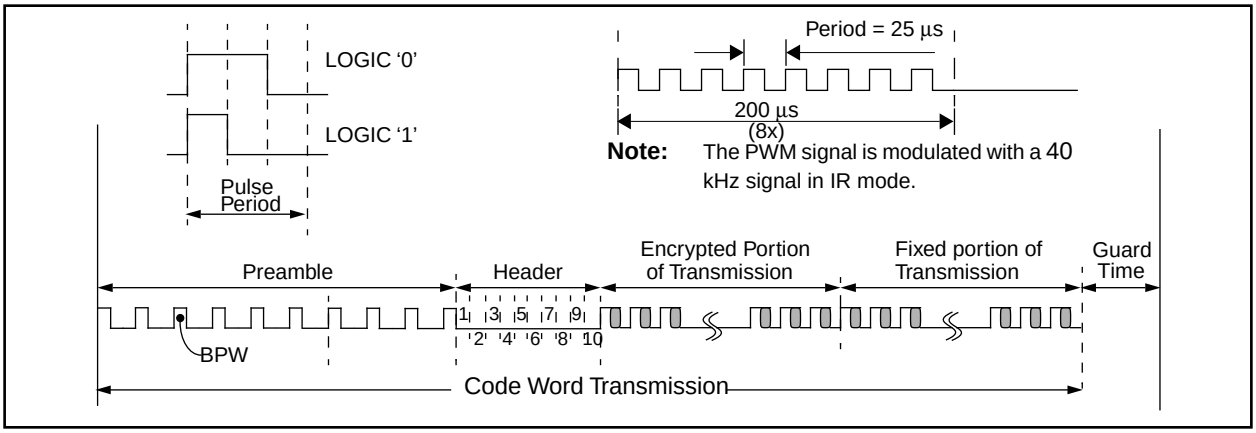


FIGURE 1-3: CODE WORD TRANSMISSION FORMAT



1.3 Transmission Format

As indicated in the Figure 1-2, the 67-bit transmitted word consists of a fixed 35-bit portion and a 32-bit encrypted data portion. The encrypted portion provides up to four billion changing code combinations and includes the function bits along with the synchronization data and discrimination values. The fixed portion is comprised of the serial number, function bits (based on which buttons were activated), VLOW bit, and 2 CRC bits. The fixed and encrypted sections combined increase the number of combinations to 1.48×10^{20}.

1.4 Learn

The HCS product family facilitates several learn strategies to be implemented on the decoder. The following are examples of what can be done. It must be pointed out that their exists some third-party patents on learning strategies and implementation.

1.4.1 NORMAL LEARN

The receiver uses the same information that is transmitted during normal operation to derive the transmitter's secret key, decrypt the discrimination value and the synchronization counter.

1.4.2 SECURE LEARN*

The transmitter is activated through a special button combination to transmit a stored 48-bit value (random seed) that can be used for key generation or be part of the key. Transmission of the random seed can be disabled after learning is completed.

1.5 Features different from the HCS300

- Transmission of the 48-bit seed value — meets GM requirements for secure learn
- 2-Bit CRC at end of transmission for data integrity check
- Blank Alternate Code Word is selectable — every second code word can be blanked
- Baud rate only selectable between fast and slow
- PWM modulation format selectable between 1/3, 2/3 and 1/6, 2/6
- Transmission of seed value on S3 (immediate) or after approximately three seconds on S0 & S1
- Independent mode — uses to independent synchronization counters (A and B) for synchronization with 2 receivers
- Infrared modulation mode on commands 12 to 15
- Serial number selectable between 28 and 32 bits
- Seed transmission can be disabled after one to 127 operations
- One overflow bit
- No envelope encryption

	S3	S2	S1	S0	Counter
1	0	0	0	1	A
2	0	0	1	0	A
3	0	0	1	1	A (Note 1)
4	0	1	0	0	A
5	0	1	0	1	A
6	0	1	1	0	A
7	0	1	1	1	A
8	1	0	0	0	B (Note 2)
8	1	0	0	0	B
9	1	0	0	1	B
10	1	0	1	0	B
11	1	0	1	1	B
12	1	1	0	0	B (Note 3)
13	1	1	0	1	B (Note 3)
14	1	1	1	0	B (Note 3)
15	1	1	1	1	B (Note 3)

Note 1: Seed transmission if enabled and after three second delay.
2: Seed transmission if enabled
3: IR modulation if enabled.

*Encoder and decoder patents are pending.

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