

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 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

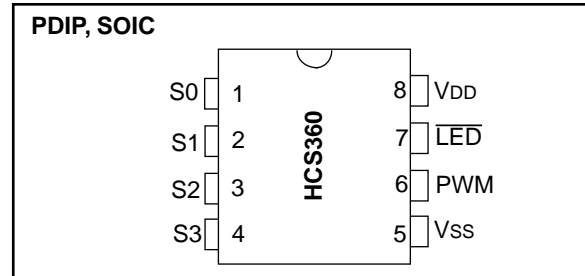
GENERAL DESCRIPTION

The Microchip Technology Inc. HCS360 is a code hopping encoder designed for OEM secure Remote Keyless Entry (RKE) systems. The HCS360 utilizes the patented KEELQ[®] 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.

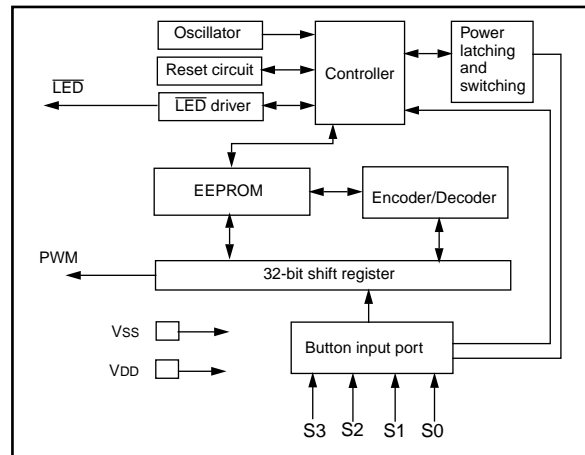
*Code hopping encoder patents allowed and pending.

KEELOQ is a registered trademark of Microchip Technology Inc.

PACKAGE TYPES



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.

HCS360

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 manufacturer's 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 KEELQOQ 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

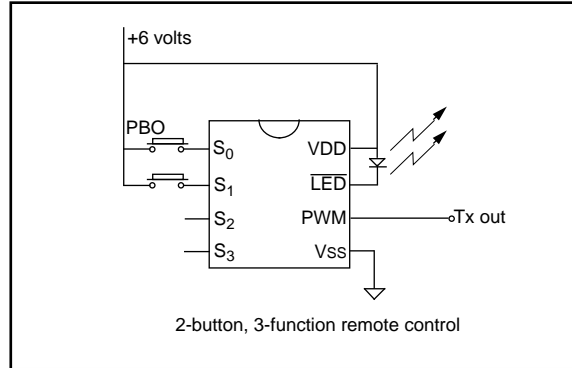


FIGURE 1-2: ENCODER OPERATION

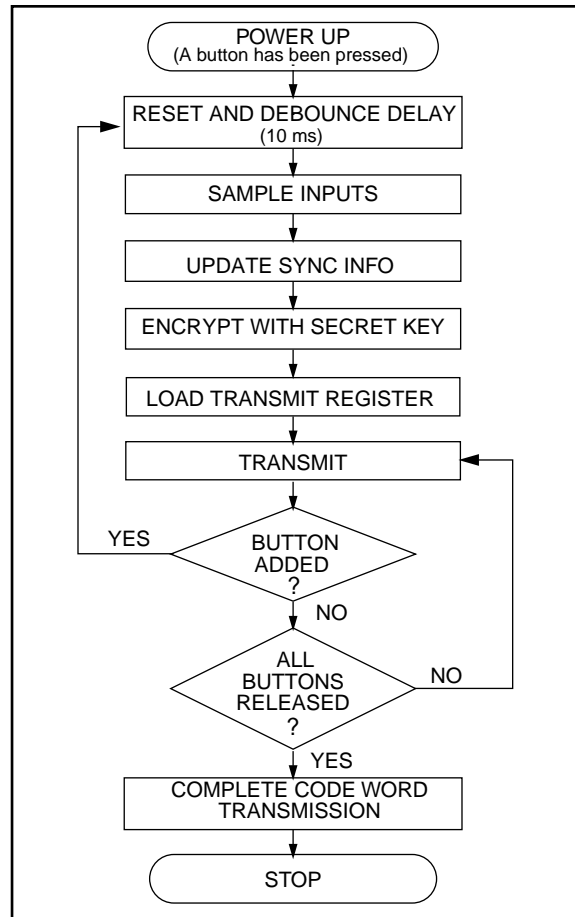
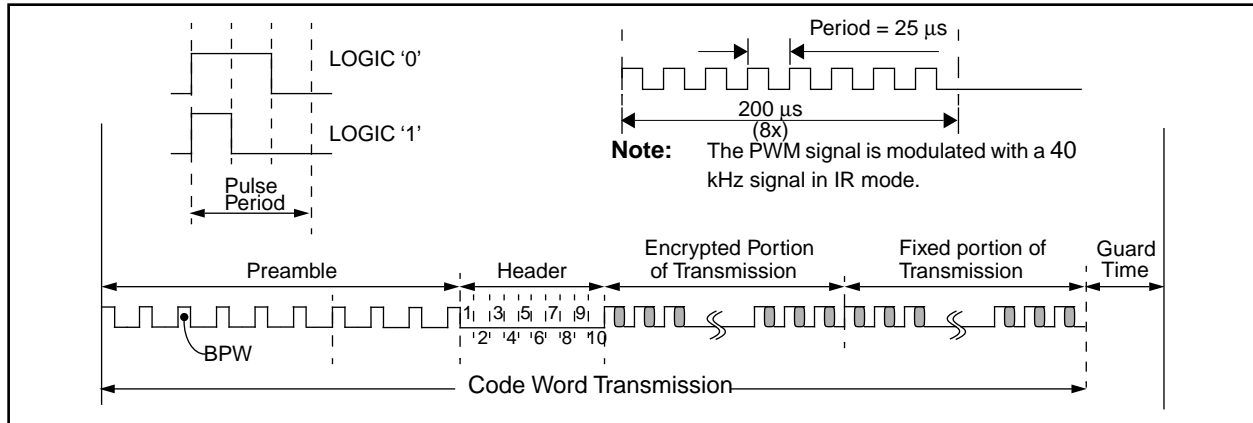


FIGURE 1-3: CODE WORD TRANSMISSION FORMAT



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 there 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.

WORLDWIDE SALES & SERVICE

AMERICAS

Corporate Office

Microchip Technology Inc.
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 602 786-7200 Fax: 602 786-7277
Technical Support: 602 786-7627
Web: <http://www.mchip.com/microchip>

Atlanta

Microchip Technology Inc.
500 Sugar Mill Road, Suite 200B
Atlanta, GA 30350
Tel: 770 640-0034 Fax: 770 640-0307

Boston

Microchip Technology Inc.
5 Mount Royal Avenue
Marlborough, MA 01752
Tel: 508 480-9990 Fax: 508 480-8575

Chicago

Microchip Technology Inc.
333 Pierce Road, Suite 180
Itasca, IL 60143
Tel: 708 285-0071 Fax: 708 285-0075

Dallas

Microchip Technology Inc.
14651 Dallas Parkway, Suite 816
Dallas, TX 75240-8809
Tel: 214 991-7177 Fax: 214 991-8588

Dayton

Microchip Technology Inc.
Suite 150
Two Prestige Place
Miamisburg, OH 45342
Tel: 513 291-1654 Fax: 513 291-9175

Los Angeles

Microchip Technology Inc.
18201 Von Karman, Suite 1090
Irvine, CA 92715
Tel: 714 263-1888 Fax: 714 263-1338

New York

Microchip Technology Inc.
150 Motor Parkway, Suite 416
Hauppauge, NY 11788
Tel: 516 273-5305 Fax: 516 273-5335

San Jose

Microchip Technology Inc.
2107 North First Street, Suite 590
San Jose, CA 95131
Tel: 408 436-7950 Fax: 408 436-7955

ASIA/PACIFIC

Hong Kong

Microchip Technology
Unit No. 3002-3004, Tower 1
Metroplaza
223 Hing Fong Road
Kwai Fong, N.T. Hong Kong
Tel: 852 2 401 1200 Fax: 852 2 401 3431

Korea

Microchip Technology
168-1, Youngbo Bldg. 3 Floor
Samsung-Dong, Kangnam-Ku,
Seoul, Korea
Tel: 82 2 554 7200 Fax: 82 2 558 5934

Singapore

Microchip Technology
200 Middle Road
#10-03 Prime Centre
Singapore 188980
Tel: 65 334 8870 Fax: 65 334 8850

Taiwan

Microchip Technology
10F-1C 207
Tung Hua North Road
Taipei, Taiwan, ROC
Tel: 886 2 717 7175 Fax: 886 2 545 0139

EUROPE

United Kingdom

Arizona Microchip Technology Ltd.
Unit 6, The Courtyard
Meadow Bank, Furlong Road
Bourne End, Buckinghamshire SL8 5AJ
Tel: 44 1 628 851077 Fax: 44 1 628 850259

France

Arizona Microchip Technology SARL
2 Rue du Buisson aux Fraises
91300 Massy - France
Tel: 33 1 69 53 63 20 Fax: 33 1 69 30 90 79

Germany

Arizona Microchip Technology GmbH
Gustav-Heinemann-Ring 125
D-81739 Muenchen, Germany
Tel: 49 89 627 144 0 Fax: 49 89 627 144 44

Italy

Arizona Microchip Technology SRL
Centro Direzionale Colleoni
Palazzo Pegaso Ingresso No. 2
Via Paracelso 23, 20041
Agrate Brianza (MI) Italy
Tel: 39 39 689 9939 Fax: 39 39 689 9883

JAPAN

Microchip Technology Intl. Inc.
Benex S-1 6F
3-18-20, Shin Yokohama
Kohoku-Ku, Yokohama
Kanagawa 222 Japan
Tel: 81 45 471 6166 Fax: 81 45 471 6122

1/05/96



MICROCHIP

All rights reserved. © 1996, Microchip Technology Incorporated, USA.

Information contained in this publication regarding device applications and the like is intended for suggestion only and may be superseded by updates. No representation or warranty is given and no liability is assumed by Microchip Technology Incorporated with respect to the accuracy or use of such information, or infringement of patents or other intellectual property rights arising from such use, or otherwise. Use of Microchip's products as critical components in medical devices is not authorized except with express written approval by Microchip. No licenses are conveyed, implicitly or otherwise, under any intellectual property rights. The Microchip logo and name are registered trademarks of Microchip Technology Inc. All rights reserved. All other trademarks mentioned herein are the property of their respective companies.