Preliminary Information

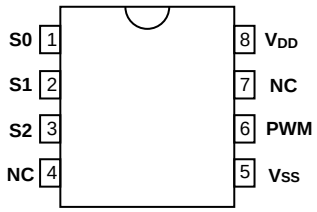
Fixed Code Encoder
A SureLok™ Security Product

FEATURES

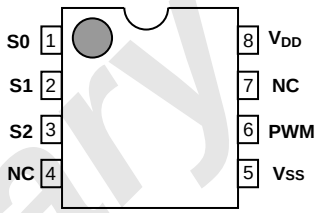
- **Low Cost Encoder**
- **28-bit fixed code transmission — 268 million code combinations**
- **Electrically programmable via E²PROM**
- **Low power indicator bit**
- **Supports up to seven switches/functions**
- **Inputs internally debounced/pulled down**
- **Dual selectable transmission baud rates**
- **Code Word Blanking**
- **EIAJ standard PDIPs and SOICs**

PIN CONFIGURATION

Plastic Dual-in-line "P" Package



EIAJ Small Outline "RF" Package



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PIN NAMES

S0-S2	Switch Inputs
NC	No Connection
V_{DD}	Supply Voltage
PWM	Pulse Width Modulated Output
V_{SS}	Ground

DESCRIPTION

The XL135 is a fixed code encoder intended for secure remote control systems. It is ideal for remote control applications using infrared (IR), microwave or radio frequency (RF) transmitters.

The 28-bit fixed code length prevents unauthorized access through code scanning. The full feature device provides low power detect, to warn the receiver that the transmitter battery is low; two selectable transmission rates to work with a variety of wireless transmission circuits; and code word blanking for FCC power rating considerations.

Designing transmitters based on the XL135 is simple, requiring no peripheral components, only push-button switches and the transmission circuitry.

Typical applications

- Vehicle RKE
- Burglar alarm systems
- Garage door openers
- Gate openers
- Home automation
- Remote fan controllers
- Home security

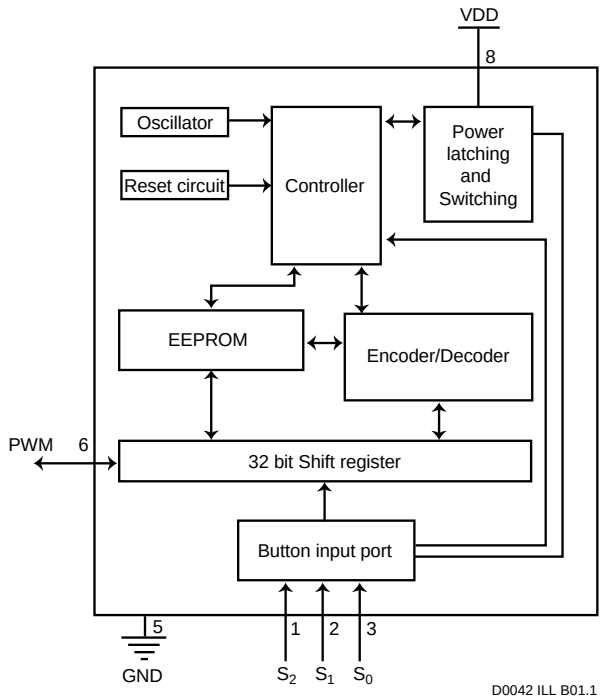
Overview

Remote control via RF or IR is popular for the control of vehicle alarms, automatic garage doors and many other applications. Conventional remote control systems have a major security shortcoming in that the number of possible code combinations is relatively small. This can lead to unauthorized access by scanning through all the possible code combinations within a short period of time.

To solve this problem, the XL135 uses a 28 bit fixed code, providing in excess of 268 million combinations, and thus prevents scanning (a complete scan would require around one year).

Significant savings in manufacturing cost can be realized through the E²PROM programability offered by the XL135, as opposed to traditional methods of setting codes such as DIP switches and soldering traces.

Functional Block Diagram



The XL135 is made possible by special hardware and design techniques along with full custom integrated circuit implementation on state of the art silicon processes.

Control input (S_0 to S_2) activation

S_2	S_1	S_0	Function	S_2	S_1	S_0	Function
0	0	0	Reset state	1	0	0	Function 4
0	0	1	Function 1	1	0	1	Function 5
0	1	0	Function 2	1	1	0	Function 6
0	1	1	Function 3	1	1	1	Function 7

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When any input (S_0 to S_2) is activated, the encoder enters a debounce period. After the debounce period, the inputs are sampled, and the function code is determined. A transmission commences, and is repeated until all buttons have been released.

If more buttons are pressed after the initial transmission has commenced, the encoder immediately resumes its power-on state, passes through the debounce period, and commences the new function code transmission. If buttons are released after the initial transmission has commenced, the transmission is not influenced. The encoder continues to repeat the same transmission until the last button is released.

As a practical example of transmitter operation, consider the case of a user that requires function 3 on a two button transmitter. The two transmitter buttons have to be pressed simultaneously. The user presses the first button first ($S_2S_1S_0 = 001$), and the transmitter commences with a function 1 transmission. When the second button is pressed ($S_2S_1S_0 = 011$), the device immediately re-enters the debounce period, without completing the current transmission, and function 3 is transmitted. Transmission will continue as long as the user is holding down at least one of the buttons.

In all cases, if all the buttons are released while a code word is being transmitted, the code word will be completed before the transmission is terminated.

Transmission rates

Two transmission rates are available. If the fast rate is selected, alternate code transmissions are blanked, resulting in a 50% reduction in duty cycle. Under U.S.A. FCC regulations, the peak transmitter output can then be doubled, hence allowing for greater transmission ranges with the same average power.

Low Power Indicator

A low power indicator bit is transmitted by the XL135 to inform the decoder that the transmitter battery is low and requires changing. The V_{BAT} status bit is zero (0) when above the battery threshold voltage and a one (1) when below it.

Implementation

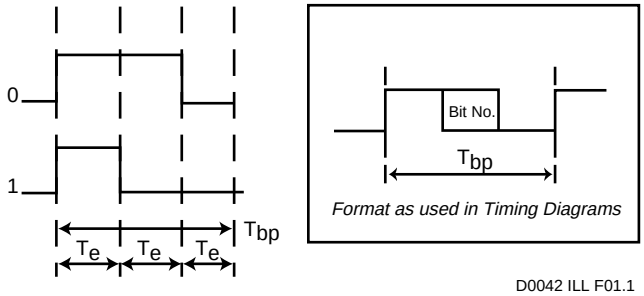
The application circuits clearly indicate the simplicity of implementations using the XL135. No DIP switches, cutting of tracks or soldering is needed. In addition, the small device footprint and no external components facilitate small PC board size and low component count. Only the XL135, transmitter circuitry and push button switches are required realizing significant savings in material and labor.

A PC based programming system is available to program each XL135 with a unique 28-bit fixed code and set the transmission baud rate. A single probe connector is typically used to program an encoder and its matching decoders.

EXEL also supplies evaluation kits to assess the operational aspects of the devices.

Timing Diagrams

Pulse Width Modulation (PWM) Format



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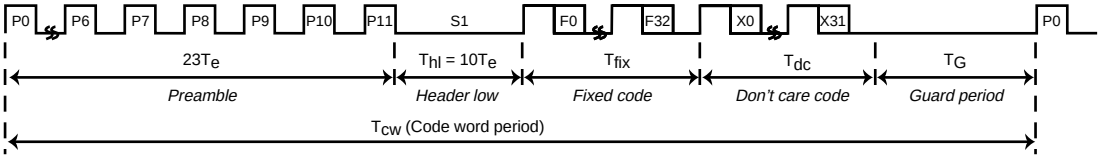
Transmission Format



P = preamble S = timing synchronization F= fixed code X= don't care code

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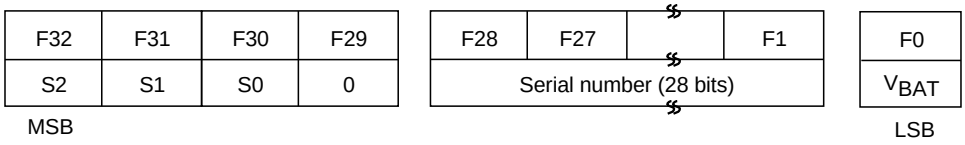
Fixed Code Format



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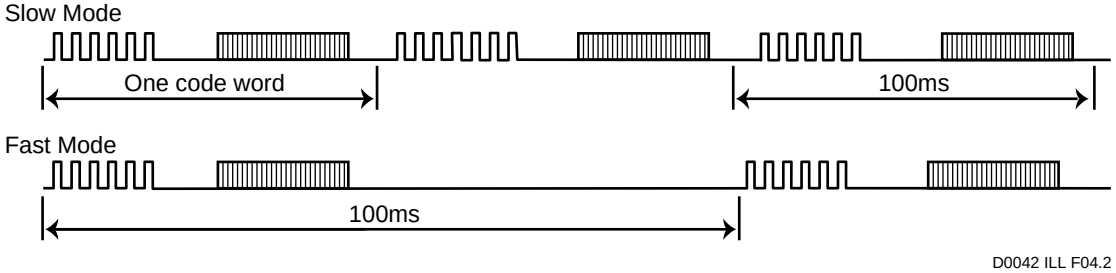
Output Transmission



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ABSOLUTE MAXIMUM RATINGS

Supply voltage ..... -0.3V to 6.5V
Voltage on any input ..... -0.3V to V_{DD} + 0.3V
Voltage on any output ..... -0.3V to V_{DD} + 0.3V
Storage temperature ..... -55°C to 125°C
Lead soldering temperature ..... 300°C
Electrostatic discharge rating 3000V

NOTE: These are STRESS ratings only. Appropriate conditions for operating these devices are given elsewhere in this specification. Stresses beyond those listed here may permanently damage the part. Prolonged exposure to maximum ratings may adversely affect device reliability.

Recommended Operating Conditions

Symbol	Description	Limits	Units
V_{DD}	Supply voltage	2.0 to 6.0	V
T_{OPR}	Operating temperature	-40 to 85	°C

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ELECTRICAL CHARACTERISTICS

DC ELECTRICAL CHARACTERISTICS

TA = -40°C to 85°C, V_{DD} = 2.0V to 6.0V

Symbol	Parameter	Test Condition	Minimum	Typical	Maximum	Units
I_{DD}	Operating supply current	V_{CC} = 5.0V		2.0	4.0	mA
		V_{CC} = 3.0V		1.0	3.0	mA
I_{res}	Standby current (reset condition)			50	1000	nA
V_{IH}	Minimum input voltage for high		0.7 V_{DD}			V
V_{IL}	Maximum input voltage for low				0.3 V_{DD}	V
V_{OH}	Minimum output voltage for high		V_{CC} -0.3			V
V_{OL}	Maximum output voltage for low				0.3	V
V_{BAT}	Battery Low threshold voltage			2.4		V
R_S	Control input pulldown resistance			60		kΩ
R_{PWM}	PWM port pulldown resistance			120		kΩ
	E^2PROM retention (power off, end of life)		10			years

D0042 PGM T03.3

AC ELECTRICAL CHARACTERISTICS, PWM OUTPUT
TA = -40°C to 85°C, V_{DD} = 2.0V to 6.0V

Symbol	Parameter	Min	Typical	Max	Units
T_e	Slow elemental period	340		500	µs
	Fast elemental period	170		250	µs
	Slow PWM data rate		780		bps
	Fast PWM data rate		1560		bps
T_{xx}	Power on to transmit		30		ms
T_{DB}	Debounce time		9		ms

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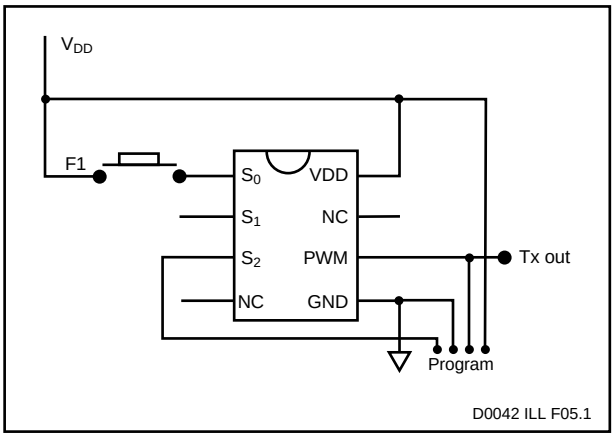
Symbol	Parameter	Slow	Fast	Units
T_{bp}	Bit period	3	3	T_e
	Preamble	23	23	T_e
T_{hl}	Header low	10	10	T_e
T_{fix}	Fixed code	99	99	T_e
T_{dc}	Don't care code	96	96	T_e
T_G	Guard period	6	240	T_e
T_{cw}	Code Word period	234	468	T_e
	Duty cycle minimum[2]	33	16	%
	maximum[2]	61	30	%

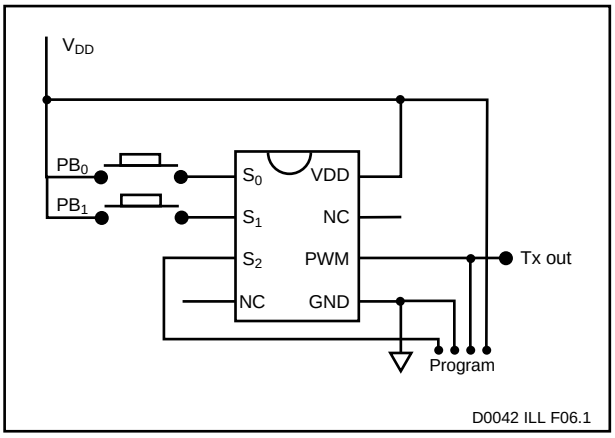
D0042 PGM T04.3

Notes:
1. Decoders must automatically compensate for data rate variations due to variation in encoder timing parameters.
2. Duty cycles are calculated by assuming 12 elements high during the preamble, and either 65 (bits all *1*) or 130 (bits all *0*) elements high during the transmitted code. For American FCC calculations, the highest duty cycle is 142 ÷ 234 (slow mode), or 142 ÷ 468 (fast mode).

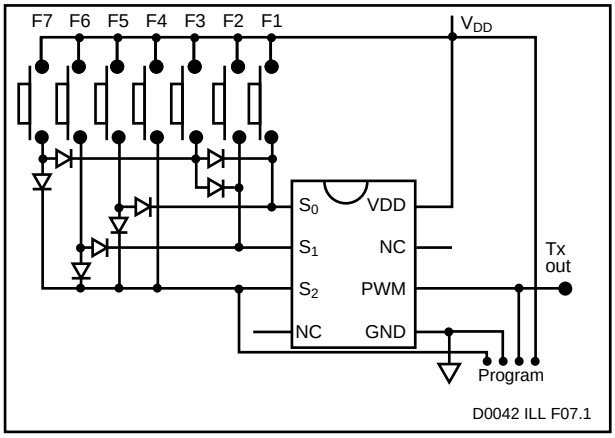
Application Circuits



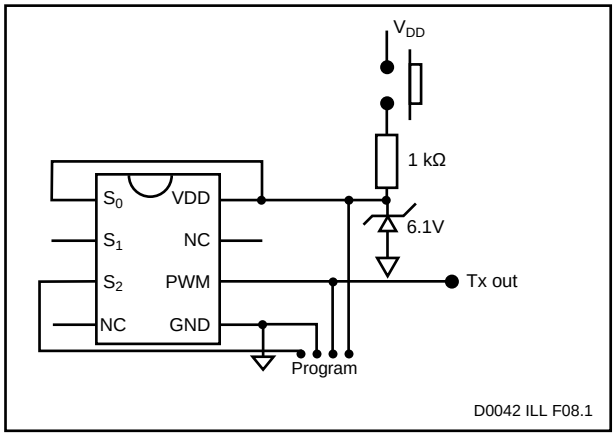
1 button remote control transmitter



3 function remote control transmitter



7 button remote control transmitter



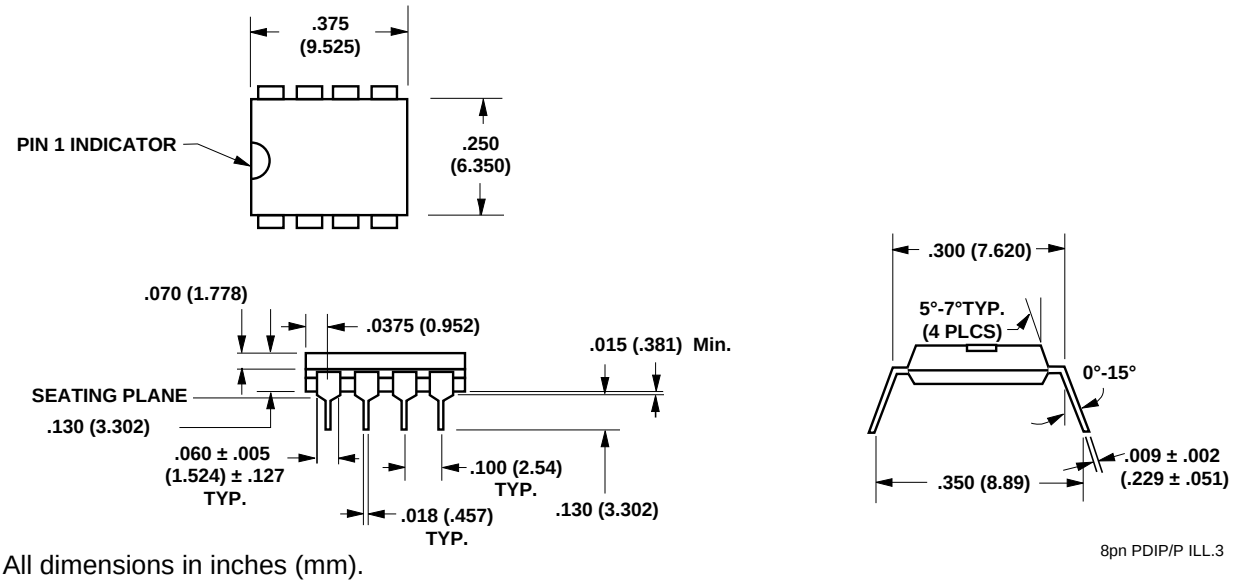
12 volt transmitter

Note: Any simpler transmitter is a subset of the circuit shown.

Note: 1. PWM may not be forced to more than 0.4 V from outside, except for communications during programming.
2. S_2 is used as a clock during programming.

PACKAGE DIAGRAMS

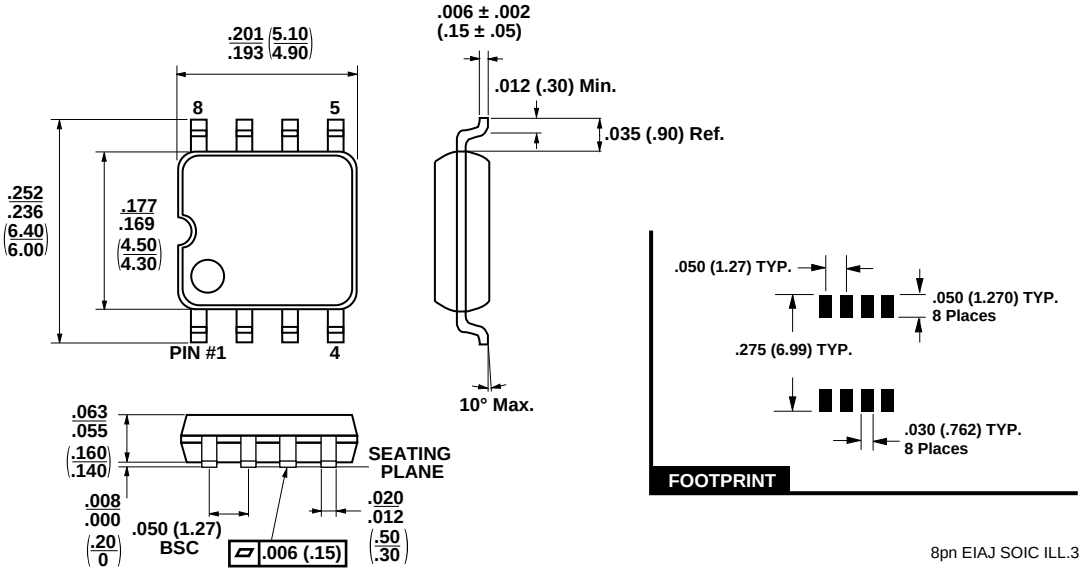
Plastic Dual-in-line (Type "P") Package (PDIP)



8pn PDIP/P ILL.3

All dimensions in inches (mm).

8 Pin SOIC (Type "F" "RF") Package EIAJ 175 mil. body width



8pn EIAJ SOIC ILL.3

All dimensions in inches (mm).

ORDERING INFORMATION

Standard Configurations

Prefix Type	Part Type	Package Type
XL	135	P, F

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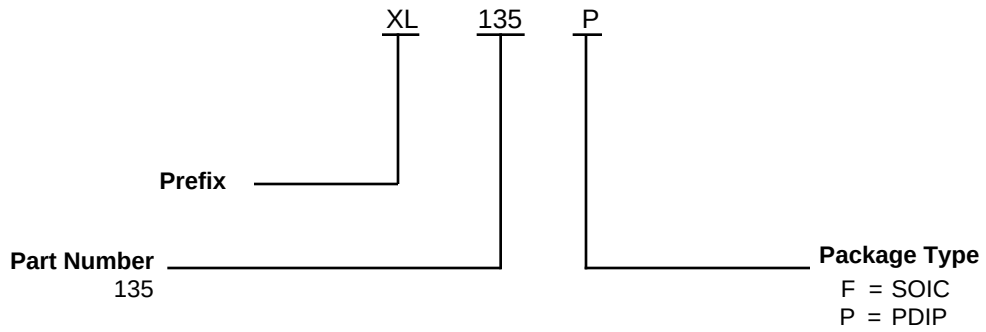
Part Numbers:

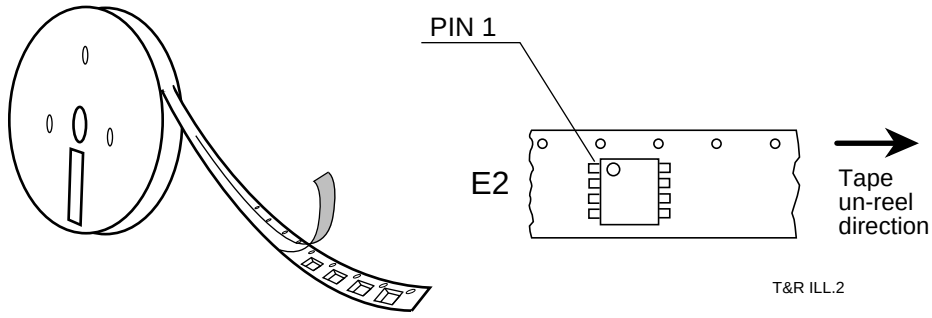


MARKING INFORMATION

D0042 ILL C01.2

TAPE AND REEL (EMBOSSED) INFORMATION

Surface mount devices, which are normally shipped in antistatic plastic tubes, are also available mounted on embossed tape for customers using automatic placement systems. The following diagram provides general information regarding the direction of the IC's. Tape "E2" shall be designated with PIN 1 at the trail direction.



T&R ILL.2

Quantity per reel: 2,500 parts

NOTES:

NOTES:

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