SIC6148

Low frequency FDX security transponder

REV 1.0

Features Summary

Highlight Features

- 125kHz FDX transponder for automotive immobilizer application
- 96-bit encryption R/W immobilizer
- On-chip resonant capacitor with calibration array

Security

- 96-bit secret key
- 32-bit pin security

Memory

- 32-bit programmable ID
- 96-bit secret key memory
- 32-bit PIN code
- 80-bit R/W user memory
- Write endurance > 200,000 R/W cycles
- Memory retention > 20 years

Revision History

Revision	Date	Description	Change/Update/Comment
1.0	27 Jan 2026	1st release	Official release

Ordering Information

Part No.	Description	Package	Marking
PG2AWDA1P20UT484VE3	SIC6148-4V, Immobilizer LF FDX with M2 96bit encryption DFN 0.75 mm, TnR, IC	IC	A2M
PG2AWDA1P20UT484XE3	SIC6148-4X, Immobilizer LF FDX with M2 96bit encryption Programmable ID DFN 0.75 mm, TnR, IC	IC	A2P
PG2AWDA1P20PK484XF2	SIC6148-4X, Immobilizer LF FDX with M2 96bit encryption Programmable ID DFN 0.75 mm, TnR, IC	IC	A2P
PG2AWDA1P20UT480XT4	SIC6148-0X, Immobilizer LF FDX with M2 96bit encryption Programmable ID DFN 0.75 mm, TnR, IC (Big reel)	IC	A2P
PG2AGT51G30HD48A1C2	SIC6148-A1, Immobilizer LF FDX with M2 96bit encryption Glass tag 125kHz, Canister, RFID TAG	Glass	-
PG2AGT51G30HD484XC2	SIC6148-4X, Immobilizer LF FDX with M2 96bit encryption Programmable ID Glass tag 125kHz, Canister, RFID TAG	Glass	-
PG2AGT51G30HD48AFC2	SIC6148-AF, Immobilizer LF FDX with M2 96bit encryption Glass tag 125kHz, Canister, RFID TAG	Glass	-

Contact sales support team for further information

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0. Notation

0.1 Styles and Fonts for Keywords

This part defines styles and fonts used for the key words throughout this document. The key words are names of signal, register, pin, state of operation and command. The styles, fonts, and their indications are shown in Table *0-1*.

Table 0-1: Style and Fonts for Keywords

Symbol	Indication
Signal	Signal name
Register	Register name or Bit name
pin RX	Pin name
"State of Operation"	State of operation
Command	Command name in register 0x01 sector 0

- To refer to a register address and a value in a register, a hexadecimal number proceeding with letter "0x" is used. For example, 0x0A.
- To refer to a set of consecutive bits located in a register address, a format ".[msb:lsb]" is used after a register value. For example, a value of 0x0A.[3:0] refers to bit 3, 2, 1, and 0 in the register 0x0A.
- To refer to a binary value in some registers, the letter "b" is placed at the end of the binary number, for example "1010b".
- To refer to logic level, the number in single quote '1' and '0' are used to refer to binary logic level.

1. General Description

SIC6148 is a low-frequency transponder that can operate at 125 kHz. The transponder contains 96-bit encryption key and 32-bit pin security. Users can read and write its memory using a specific SIC6148 protocol.

- 125kHz FDX transponder for automotive immobilizer application
- 96-bit encryption R/W immobilizer
- On-chip resonant capacitor with calibration array
- Security
  - 96-bit secret key
  - 32-bit pin security
- Memory
  - 32-bit programmable ID
  - 96-bit secret key memory
  - 32-bit PIN code
  - 80-bit R/W user memory
- Write endurance > 200,000 R/W cycles
- Memory retention > 20 years

2. Block Diagram

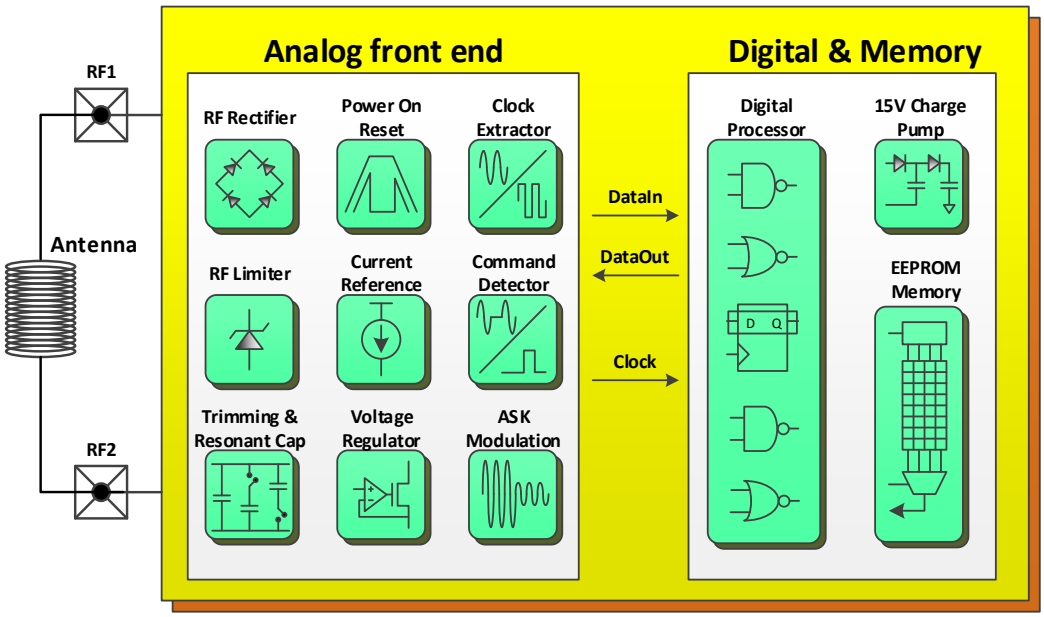

Figure 2-1: SIC6148 Block Diagram

3. Functional Description

SIC6148 operates as a 125-kHz encryption transponder with 96-bit encryption key. Users can read and write memory using a specific SIC6148 protocol, which is a tag-talk-first protocol.

3.1 Memory Organization

SIC6148 memory consists of 256 bits EEPROM that is organized as 16 words with 16 bits for each word. Word 0 and word 1 are user memory area 1. The word 1 also contains lock bits LB1 and LB0. If LB0 is set to logical '1', all words are write-protected. LB1 is not used. Word 2 and word 3 are the identification data. Words 4 to word 9 contain the 96-bit secret key that is used for authentication and cannot be read directly. Word 10 and word 11 are the PIN code, which also cannot be read directly. The PIN code memory is the secret code that is used for resetting LB0 to logical '0'. Words 12 to 16 are user memory area 2.

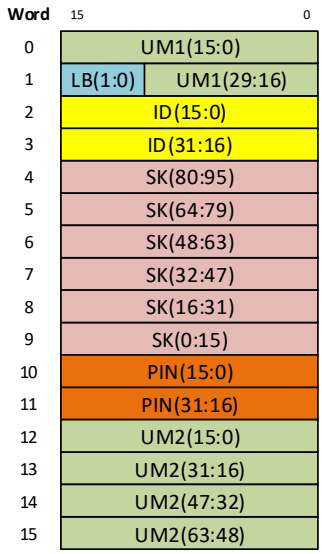

Figure 3-1: SIC6148 Memory Organization

3.2 Communication and Protocol

SIC6148 transmission is full duplex (FDX) method. The transponder receives power from the reader's RF field. The transponder and the reader communicate by modulating the amplitude of the field.

Communication from Transponder to Transceiver (READ MODE)

SIC6148 transmits data to the reader serially using Manchester code with data rate RF/32.

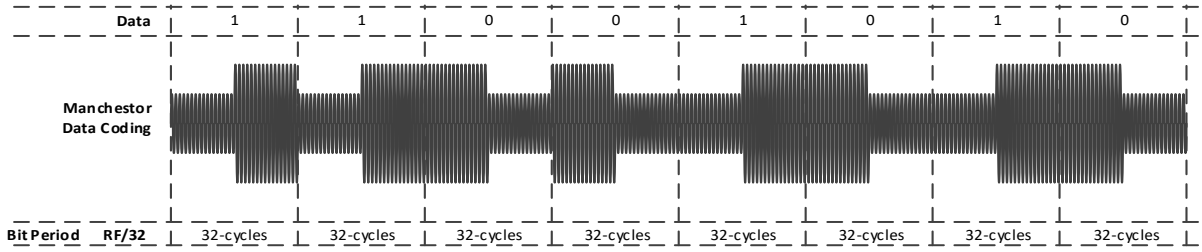

Figure 3-2: Data Coding in SIC6148

SIC6148 sends different patterns to the reader to indicate its status. The Listen Window (LIW) is the pattern to inform the reader that it is in the stand-by mode. The acknowledge (ACK) and the no-acknowledge (NAK) patterns indicate result of an operation. If operation is success, ACK response will occur. If error condition occurs, the status will be NAK instead. The period of one bit for these patterns are 32 clock cycles.

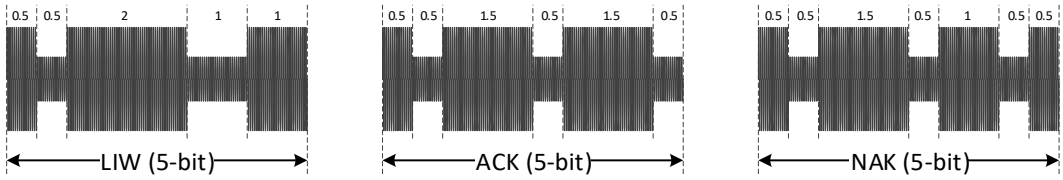

Figure 3-3: LIW, ACK, and NAK Patterns

Before sending response that consists of data in the memory, the transponder starts the response frame with 16-bit header (1111 1111 1111 0000) as shown in Figure 3-*4*.

H = 1111 1111 1111 0000

Figure 3-4: Header of SIC6148 Response

Communication from Transceiver to Transponder (RECEIVE MODE)

SIC6148 switches to the command reception mode when the RM is detected during LIW period. The RM consists of the 2 bits of data '0' (D0). The data rate of the RM bit and subsequent command bits must correspond to RF/32 bit rate. It is recommended to align the off-field period of data '0' bits to the modulation period of LIW pattern.

If RM is valid, the tag will enter the SIC6148 receiving command mode. The modulation ON and modulation OFF are a half of data rate ($T_{bit,P/2}$). The command bit (D0 or D1) to be sent must be synchronized with the transponder's data rate.

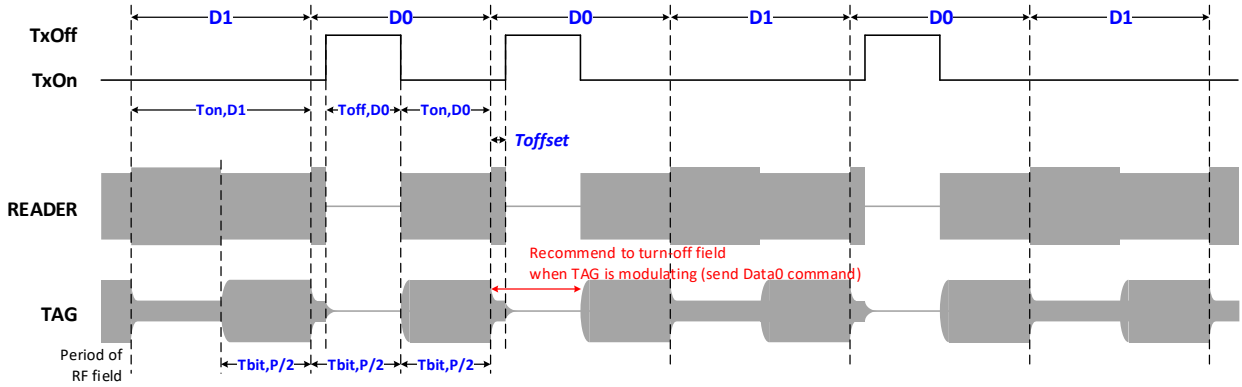

Figure 3-5: Command Protocol in SIC6148

Table 3-1: SIC6148 Timing Characteristic

Parameter	Symbol	Min	Typ	Max	Unit
Initial Time	T_{init}			600	μs
Bit Period	$T_{bit,P}$		32		Cycle
Data0 Command	D0		32		Cycle
Data0 Off-Field(1)	$T_{off,D0}$	8	16	32	Cycle
Data0 On-Field	$T_{on,D0}$		16		Cycle
Data1 Command	D1		32		Cycle
Data1 On-Field	$T_{on,D1}$		32		Cycle
Command Offset	T_{offset}	1		4	Cycle
Waiting Time	T_{wait}		128		Cycle
Waiting Time of *Send PIN*	$T_{wait,SP}$		672		Cycle
Writing Time	T_{write}		3072		Cycle
Encrypting Time	T_{enc}		224		Cycle

(1) Depend on Q-factor of coil

4. Transponder Characteristic

4.1 Absolute Maximum Rating

Table 4-1: Absolute Maximum Rating

Parameter	MIN.	NOM.	MAX.	Unit	Condition
Operating Frequency	100		150	kHz	
Operating Temperature (read)	-40		+85	°C	
Operating Temperature (program)	-40		+85	°C	
Maximum Field Strength			160	dBμA/m	@125kHz, Q50

4.2 Electrical Characteristic

Table 4-2: Electrical Characteristic

PARAMETER	SYMBOL	MIN	NOM	MAX	UNIT	CONDITION
Resonance frequency	f_{res}	122	125	128	kHz	+25 °C
Clamping RF voltage level	V_H	10.4	10.6	10.9	V	I_{RF} 1mA to 25 mA
Modulating RF voltage level	V_L	1.2	1.4	2.5	V	I_{RF} 1mA to 25 mA
Power-On Reset RF level	$V_{RF,Por}$	2.0	2.2	2.4	V	
Command reception level	$V_{RF,Cmd}$	2.5			V	
Programming RF level	$V_{RF,Prog}$	5.8			V	
Based resonant capacitor	C_{res}		233		pF	V_H 1.5V
Tuning resonant capacitor	C_T	0		60	pF	V_H 1.5V
Tuned resonant capacitor	$C_{res}+C_T$		267		pF	V_H 1.5V
Coil inductance	L		6.0		mH	
Q-factor	Q		50		-	125kHz

4.3 Environment and Data Reliability

Table 4-3: Environment and Data Reliability

PARAMETER	SYMBOL	MIN	NOM	MAX	UNIT
ESD Immunity		IEC 801-2		>2kV	
Storage Temperature	T_{sto}	-40°C to +90°C		1,000 hr	
Temperature Shock	T_{shock}	Low temperature: High temperature: Number of cycles: Soaking time: Transition time:		-40°C +90°C 100 5 min 30 sec	
Drop		100 times		2 m	
Shock		IEC 68-2-29			
Vibration		IEC 68-2-6			
Programming cycle		>200,000 times		25°C	
Data retention		>20 years		20°C	

4.4 Physical Characteristic

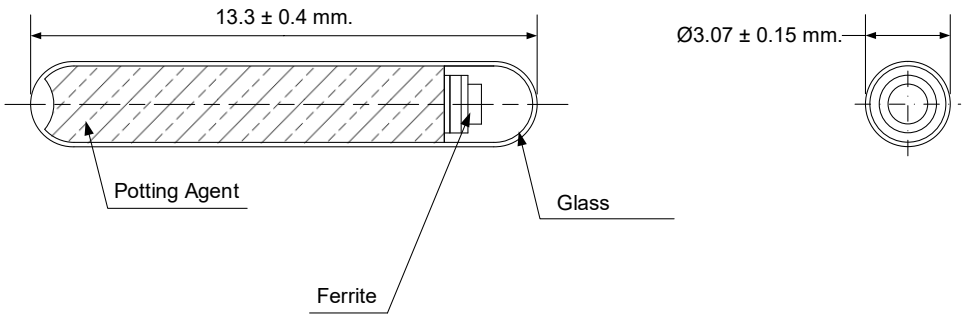

Figure 4-1: Glass Transponder Drawing

Table 4-4: Physical Characteristic

Parameter	Symbol	MIN.	NOM.	MAX.	Unit
Diameter	OD	2.92	3.07	3.22	mm
Length	L	12.9	13.3	13.7	mm
Housing material			Glass		
Color			Dark		
Immersion at room temperature			IP-68		

4.5 Outline Drawing (IC Package)

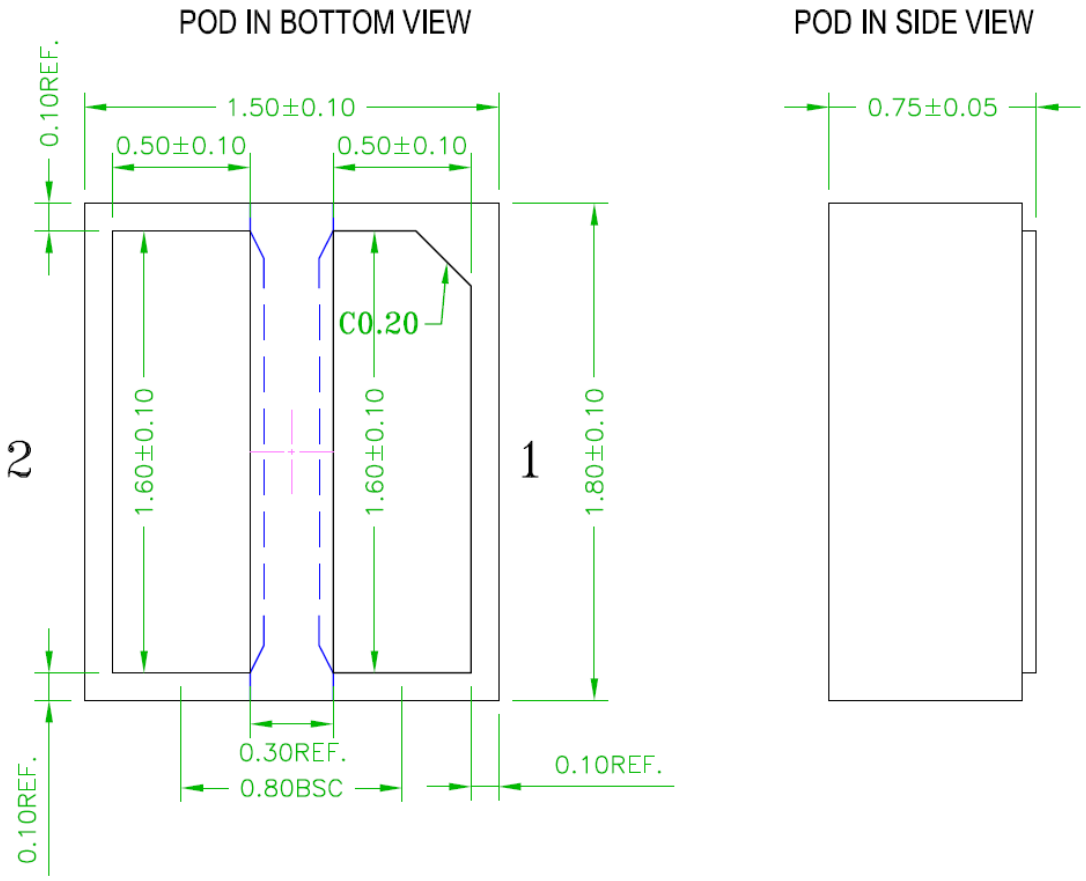

Figure 4-2: Integrated Circuit Drawing

5. Disclaimer

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