

Using OTP Regions in S25FL-P SPI Multi I/O Flash

AN98515 discusses the approaches to using the One-Time Programmable (OTP) area of up to 128-bits (16 bytes) for permanent secure identification using an Electronic Serial Number (ESN) and an additional 490 bytes of OTP space for customer use with Cypress's S25FL-P MirrorBit® SPI Multi-I/O Flash Memory family devices.

1 Introduction

The S25FL-P MirrorBit® SPI Multi-I/O Flash Memory family supports a One-Time Programmable (OTP) area of up to 128-bits (16 bytes) for permanent secure identification using an Electronic Serial Number (ESN) and an additional 490 bytes of OTP space for customer use. The ESN can be programmed and locked at the factory or by the customer. The OTP area can be programmed or read using the OTP Program (OTPP) or Read OTP Data Bytes (OTPR) instructions respectively. The OTP Program command programs a bit or group of bits in an OTP address space data byte from '1' (erased) to '0' (programmed). The OTP memory space can be programmed one or more times, provided that the OTP memory space is not locked. Subsequent OTP programming can be performed only on the unprogrammed bits (that is, '1' data) since OTP Region bits programmed to '0' cannot be erased.

2 OTP Regions

The OTP Regions are separately addressable from the main flash array and consist of two 8-byte (ESN), thirty 16-byte, and one 10-byte regions that can be individually locked as shown in the OTP Region Memory Map [Figure 1](#) and [Figure 2](#).

2.1 ESN Region

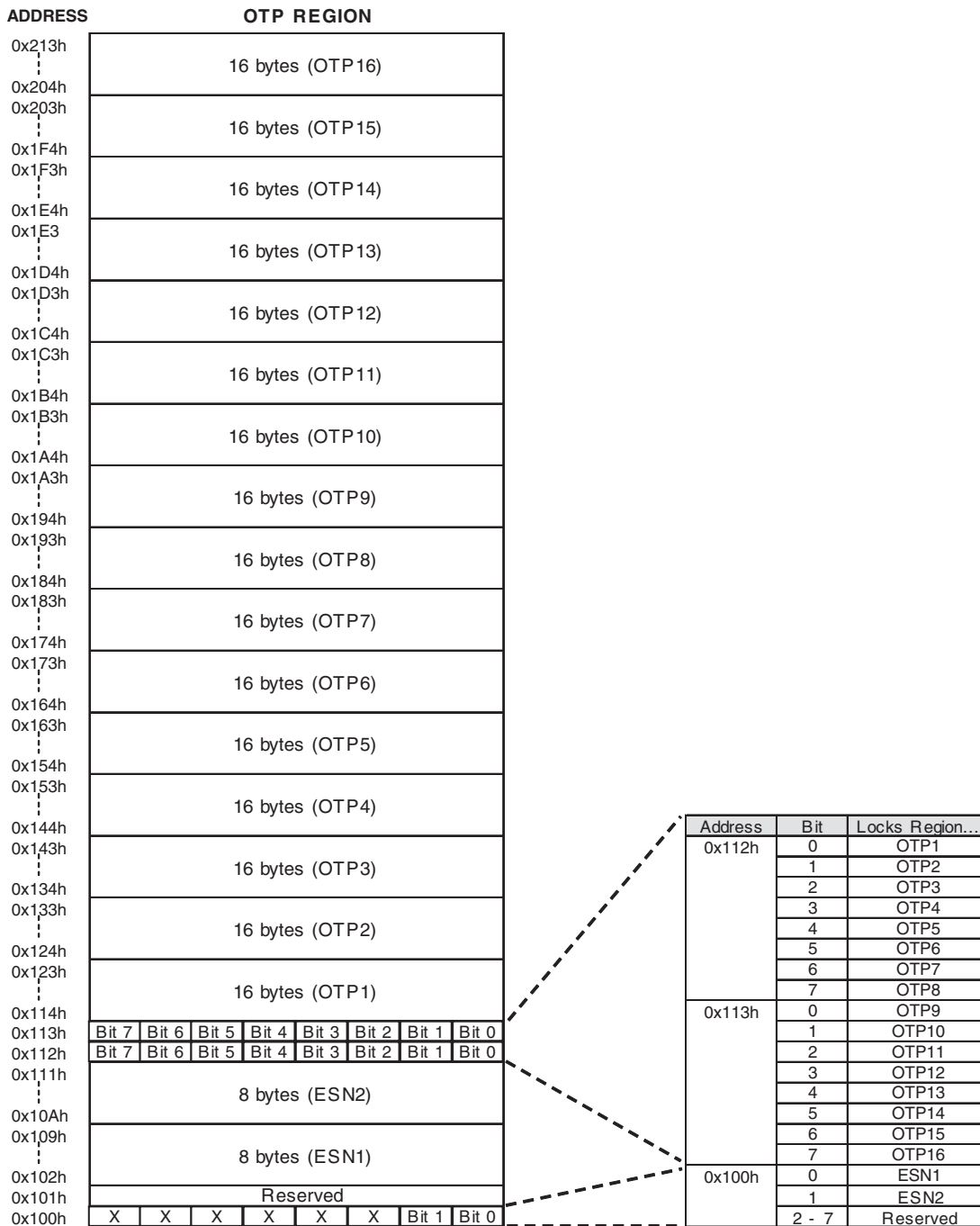
The ESN Region consists of two 8-byte Electronic Serial Number (ESN) regions located at OTP address 0x102h (ESN1) and OTP address 0x10Ah (ESN2). When set to '0', Bit 0 at OTP address 0x100h locks the ESN1 region, and Bit 1 at OTP address 0x100h locks the ESN2 region.

In the standard part, the ESN1 and ESN2 Regions are unprogrammed with FFh data and are unlocked as shown in [Table 1](#). With the Special order part (please contact your local Cypress sales representative for further details), the Cypress factory programs and locks the lower 8-byte ESN1 with a 64-bit randomly generated, unique number. The upper 8-byte ESN2 is left blank for customer use or, if special ordered, Cypress can program (and lock) in a unique customer ID.

Table 1. ESN Region Options

	ESN1 Lock Bit OTP Address 0x100 Bit 0	ESN2 Lock Bit OTP Address 0x100 Bit 1	ESN1 Region Data	ESN2 Region Data
Standard part	1h	1h	FFh	FFh
Special order part	0h	0h/1h	Unique random pattern	Factory/Customer programmed pattern

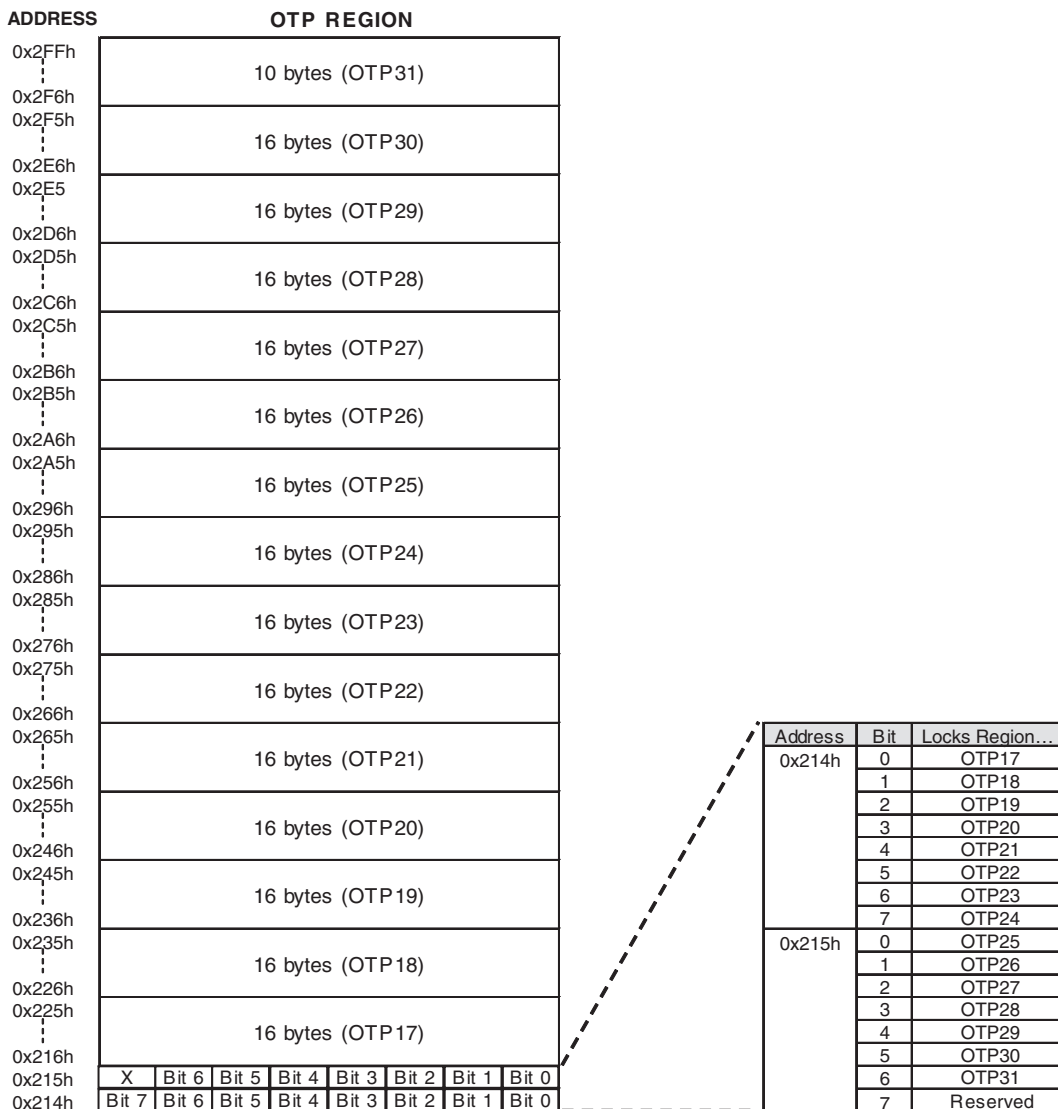
Figure 1. OTP Region Memory Map (ESN and OTP1:OTP16)



Notes:

1. Bit 0 at address 0x100h locks ESN1 region.
2. Bit 1 at address 0x100h locks ESN2 region.
3. Bits 2-7 ("X") are NOT programmable and will be ignored.

Figure 2. OTP Region Memory Map (OTP17:OTP31)



Note:

1. Bit 7 ("X") at address 0x215h is NOT programmable and will be ignored.

2.2 Customer OTP Regions

The thirty 16-byte (OTP1:OTP16, OTP17:OTP30) and one 10-byte OTP31 regions are by default unlocked and available for customer programmed data and can be individually locked by the end user. Once locked, the data cannot be changed. The locking process is permanent and cannot be reversed.

As shown in Figure 1, OTP1 through OTP16 data bytes can be addressed in 16-byte regions from 0x114h to 0x213h in the OTP address space and can be individually locked using the corresponding Bit at OTP address 0x112h and 0x113h. For example, OTP1 can be programmed using the OTPP (OTP Program) command for each of the 16 data bytes located in the OTP address space from 0x114h to 0x123h as required. After programming, the OTP1 Region can be permanently locked by setting Bit 0 at OTP address 0x112h to '0' using the OTPP (OTP Program) command.

In Figure 2, OTP17 through OTP30 data bytes can be addressed in 16-byte regions from 0x216h to 0x2F5h in the OTP address space and can be individually locked using the corresponding Bit at OTP address 0x214h and 0x215h. For example, OTP27 can be programmed using the OTPP (OTP Program) command for each of the 16 data bytes located in the OTP address space from 0x2B6h to 0x2C5h as required. After programming, the OTP27 Region can be permanently locked by setting Bit 2 at OTP address 0x215h to '0' using the OTPP (OTP Program) command.

The 10-byte OTP31 region can be programmed using the OTPPP (OTP Program) command for each of the 10 data bytes located in the OTP address space from 0x2F6h to 0x2FFh as required. After programming, the OTP31 Region can be permanently locked by setting Bit 6 at OTP address 0x215h to '0' using the OTPPP (OTP Program) command.

2.3 Special OTP Region Considerations

- On power-up, or following a hardware reset, or at the end of an OTPPP or an OTPR command, the device reverts to sending commands to the normal address space.
- To program the OTP in bit granularity, the rest of the bits within the data byte can be set to '1'.
- OTP Program operations outside the valid OTP address range will be ignored.
- OTP Read operations outside the valid OTP address range will yield indeterminate data.
- The OTP Region is not accessible when the device is executing an Embedded Program or Embedded Erase algorithm.
- The ACC function is not available when accessing the OTP Regions.
- If an application requires certain OTP regions to be unlocked, special care may be needed to prevent malicious permanent locking of the requisite OTP regions.

3 Summary

The OTP Region can be used for ESN and customer data and can be permanently locked after programming. With the Special order part, the Cypress factory programs and locks the lower 8-byte ESN1 with a 64-bit randomly generated, unique number, and optionally Cypress can also program and lock a unique customer ID into the upper 8-byte ESN2.

Please refer to the specific S25FL-P SPI Multi-I/O Flash device data sheet for complete details on using the OTP Program (OTPP) or Read OTP Data Bytes (OTPR) commands.

4 References

- Cypress S25FL032P Data Sheet (S25FL032P_00)
- Cypress S25FL064P Data Sheet (S25FL064P_00)
- Cypress S25FL129P Data Sheet (S25FL129P_00)
- Cypress S70FL256P Data Sheet (S70FL256P_00)

Document History Page

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Rev.	ECN No.	Orig. of Change	Submission Date	Description of Change
**	-	-	01/26/2011	Initial version
*A	4928192	MSWI	09/21/2015	Updated to Cypress template
*B	5872348	AESATMP8	09/05/2017	Updated logo and Copyright.
*C	5994430	BACD	12/14/2017	No technical updates. Completing Sunset Review.

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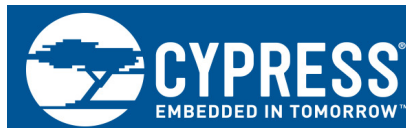
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