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# TMAC Test Vectors

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**Abstract.** In this paper, we present test vectors for TMAC, Two-Key CBC Message Authentication Code proposed by the authors. The test vectors are given for implementations in which the underlying block cipher is Rijndael, for 128, 192 and 256 bit keys.

## 1 Introduction

In this paper, we present test vectors for TMAC, Two-Key CBC Message Authentication Code proposed by the authors. The test vectors are given for implementations in which the underlying block cipher is Rijndael, for 128, 192 and 256 bit keys. See [4] for a specification of TMAC, and [3, 1] for a specification of Rijndael.

## 2 Test Vectors

All strings are expressed in hexadecimal notation. We present 24 examples for TMAC with Rijndael as the underlying block cipher: 8 examples are given for each of the allowed key sizes (128, 192, and 256 bits). TMAC uses two keys,  $K_1$  and  $K_2$ , where  $K_1$  is used as a key of Rijndael. We used  $K_1$  such that

$$K_1 = \begin{cases} 2b7e151628aed2a6abf7158809cf4f3c & \text{for 128 bit key,} \\ \begin{cases} 8e73b0f7da0e6452c810f32b809079e5 \\ 62f8ead2522c6b7b \end{cases} & \text{for 192 bit key, and} \\ \begin{cases} 603deb1015ca71be2b73aef0857d7781 \\ 1f352c073b6108d72d9810a30914dff4 \end{cases} & \text{for 256 bit key.} \end{cases}$$

These values are taken from [2].

We used  $K_2$  such that

$$K_2 = \begin{cases} 000102030405060708090a0b0c0d0e0f, \text{ and} \\ f0f1f2f3f4f5f6f7f8f9fafbfcfdfeff. \end{cases}$$

The messages which we used are the first 0, 16, 40, and 64 bytes of

```
6bc1bee22e409f96e93d7e117393172a
ae2d8a571e03ac9c9eb76fac45af8e51
30c81c46a35ce411e5fbc1191a0a52ef
f69f2445df4f9b17ad2b417be66c3710
```

This is also taken from [2]. Note that, for each  $K_1$ , there are eight combinations of two  $K_2$ 's and four messages.

In what follows, the message is denoted by “Msg” and the output is denoted by “Tag.”

## 2.1 TMAC-AES-128

### Test Vectors for the Empty String

```
 $K_1$  2b7e151628aed2a6abf7158809cf4f3c
 $K_2$  000102030405060708090a0b0c0d0e0f
Msg <empty string>
Tag 4c08220c79d9191022dc6674874ceaf8
```

```
 $K_1$  2b7e151628aed2a6abf7158809cf4f3c
 $K_2$  f0f1f2f3f4f5f6f7f8f9fafbfcfdfeff
Msg <empty string>
Tag 10188a5b5c45e61980fb1522a7fbfff9
```

### Test Vectors for 16 Byte Message

```
 $K_1$  2b7e151628aed2a6abf7158809cf4f3c
 $K_2$  000102030405060708090a0b0c0d0e0f
Msg 6bc1bee22e409f96e93d7e117393172a
Tag 6c3076442eead2741dd08057a2f51f44
```

```
 $K_1$  2b7e151628aed2a6abf7158809cf4f3c
 $K_2$  f0f1f2f3f4f5f6f7f8f9fafbfcfdfeff
Msg 6bc1bee22e409f96e93d7e117393172a
Tag 7de51936b6be2b46fb5665cbb763992e
```

### Test Vectors for 40 Byte Message

```
 $K_1$  2b7e151628aed2a6abf7158809cf4f3c
 $K_2$  000102030405060708090a0b0c0d0e0f
Msg 6bc1bee22e409f96e93d7e117393172a
    ae2d8a571e03ac9c9eb76fac45af8e51
    30c81c46a35ce411
Tag b656b827eabdf8e5d7f460e9f5100769
```

$K_1$  2b7e151628aed2a6abf7158809cf4f3c  
 $K_2$  f0f1f2f3f4f5f6f7f8f9fafbfcdfeff  
Msg 6bc1bee22e409f96e93d7e117393172a  
ae2d8a571e03ac9c9eb76fac45af8e51  
30c81c46a35ce411  
Tag 01134f8efe7c1f6e288a0868b25440a8

### Test Vectors for 64 Byte Message

$K_1$  2b7e151628aed2a6abf7158809cf4f3c  
 $K_2$  000102030405060708090a0b0c0d0e0f  
Msg 6bc1bee22e409f96e93d7e117393172a  
ae2d8a571e03ac9c9eb76fac45af8e51  
30c81c46a35ce411e5fbc1191a0a52ef  
f69f2445df4f9b17ad2b417be66c3710  
Tag 07aa2747781f841879218ca8e6a7a3db

$K_1$  2b7e151628aed2a6abf7158809cf4f3c  
 $K_2$  f0f1f2f3f4f5f6f7f8f9fafbfcdfeff  
Msg 6bc1bee22e409f96e93d7e117393172a  
ae2d8a571e03ac9c9eb76fac45af8e51  
30c81c46a35ce411e5fbc1191a0a52ef  
f69f2445df4f9b17ad2b417be66c3710  
Tag e262051676b73dc06cc3d34973e8d0fe

## 2.2 TMAC-AES-192

### Test Vectors for the Empty String

$K_1$  8e73b0f7da0e6452c810f32b809079e5  
62f8ead2522c6b7b  
 $K_2$  000102030405060708090a0b0c0d0e0f  
Msg  $\langle$ empty string $\rangle$   
Tag 09aa07477468e56f850c577c39b5e095

$K_1$  8e73b0f7da0e6452c810f32b809079e5  
62f8ead2522c6b7b  
 $K_2$  f0f1f2f3f4f5f6f7f8f9fafbfcdfeff  
Msg  $\langle$ empty string $\rangle$   
Tag a1bdcf836dfe669f32af3da04600d07e

### Test Vectors for 16 Byte Message

$K_1$  8e73b0f7da0e6452c810f32b809079e5  
62f8ead2522c6b7b  
 $K_2$  000102030405060708090a0b0c0d0e0f  
Msg 6bc1bee22e409f96e93d7e117393172a  
Tag 275546ed5f9bc5d4468029af259dba4d

$K_1$  8e73b0f7da0e6452c810f32b809079e5  
62f8ead2522c6b7b  
 $K_2$  f0f1f2f3f4f5f6f7f8f9fafbfcfdfeff  
Msg 6bc1bee22e409f96e93d7e117393172a  
Tag 4b37cf17046ccbbb3fdc0271b68c2e96

#### Test Vectors for 40 Byte Message

$K_1$  8e73b0f7da0e6452c810f32b809079e5  
62f8ead2522c6b7b  
 $K_2$  000102030405060708090a0b0c0d0e0f  
Msg 6bc1bee22e409f96e93d7e117393172a  
ae2d8a571e03ac9c9eb76fac45af8e51  
30c81c46a35ce411  
Tag 750d69ef72e5ee9de8a1ec1b961ec093

$K_1$  8e73b0f7da0e6452c810f32b809079e5  
62f8ead2522c6b7b  
 $K_2$  f0f1f2f3f4f5f6f7f8f9fafbfcfdfeff  
Msg 6bc1bee22e409f96e93d7e117393172a  
ae2d8a571e03ac9c9eb76fac45af8e51  
30c81c46a35ce411  
Tag 2daec77528de8c2b27b7a923bccb2cf5

#### Test Vectors for 64 Byte Message

$K_1$  8e73b0f7da0e6452c810f32b809079e5  
62f8ead2522c6b7b  
 $K_2$  000102030405060708090a0b0c0d0e0f  
Msg 6bc1bee22e409f96e93d7e117393172a  
ae2d8a571e03ac9c9eb76fac45af8e51  
30c81c46a35ce411e5fbc1191a0a52ef  
f69f2445df4f9b17ad2b417be66c3710  
Tag 3197b08265b5d4016af0273eb1b11d65

$K_1$  8e73b0f7da0e6452c810f32b809079e5  
62f8ead2522c6b7b  
 $K_2$  f0f1f2f3f4f5f6f7f8f9fafbfcfdfeff  
Msg 6bc1bee22e409f96e93d7e117393172a  
ae2d8a571e03ac9c9eb76fac45af8e51  
30c81c46a35ce411e5fbc1191a0a52ef  
f69f2445df4f9b17ad2b417be66c3710  
Tag a9e5ede6366364b34be1deb036821fb5

### 2.3 TMAC-AES-256

#### Test Vectors for the Empty String

$K_1$  603deb1015ca71be2b73aef0857d7781  
1f352c073b6108d72d9810a30914dff4  
 $K_2$  000102030405060708090a0b0c0d0e0f  
Msg (empty string)  
Tag 3ca4c401acc469502d6eb9fbe1dc48b

$K_1$  603deb1015ca71be2b73aef0857d7781  
1f352c073b6108d72d9810a30914dff4  
 $K_2$  f0f1f2f3f4f5f6f7f8f9fafbfcfdfeff  
Msg (empty string)  
Tag 8c6c871e4923f23d6a9a995b820e8574

#### Test Vectors for 16 Byte Message

$K_1$  603deb1015ca71be2b73aef0857d7781  
1f352c073b6108d72d9810a30914dff4  
 $K_2$  000102030405060708090a0b0c0d0e0f  
Msg 6bc1bee22e409f96e93d7e117393172a  
Tag 031b585bf5108a462e42fe48a0d1e0a1

$K_1$  603deb1015ca71be2b73aef0857d7781  
1f352c073b6108d72d9810a30914dff4  
 $K_2$  f0f1f2f3f4f5f6f7f8f9fafbfcfdfeff  
Msg 6bc1bee22e409f96e93d7e117393172a  
Tag c35d2efdee829cb0a49386deb5c9ecf

#### Test Vectors for 40 Byte Message

$K_1$  603deb1015ca71be2b73aef0857d7781  
1f352c073b6108d72d9810a30914dff4  
 $K_2$  000102030405060708090a0b0c0d0e0f  
Msg 6bc1bee22e409f96e93d7e117393172a  
ae2d8a571e03ac9c9eb76fac45af8e51  
30c81c46a35ce411  
Tag 8d4889ac80d32677c25695dafaf61090

$K_1$  603deb1015ca71be2b73aef0857d7781  
1f352c073b6108d72d9810a30914dff4  
 $K_2$  f0f1f2f3f4f5f6f7f8f9fafbfcfdfeff  
Msg 6bc1bee22e409f96e93d7e117393172a  
ae2d8a571e03ac9c9eb76fac45af8e51  
30c81c46a35ce411  
Tag d5a2b0d78a85a298b7a7ab2b91c89df9

## Test Vectors for 64 Byte Message

$K_1$  603deb1015ca71be2b73aef0857d7781  
1f352c073b6108d72d9810a30914dff4  
 $K_2$  000102030405060708090a0b0c0d0e0f  
Msg 6bc1bee22e409f96e93d7e117393172a  
ae2d8a571e03ac9c9eb76fac45af8e51  
30c81c46a35ce411e5fbc1191a0a52ef  
f69f2445df4f9b17ad2b417be66c3710  
Tag bacbfafc54dea13de2bb983d0f5eea7f

$K_1$  603deb1015ca71be2b73aef0857d7781  
1f352c073b6108d72d9810a30914dff4  
 $K_2$  f0f1f2f3f4f5f6f7f8f9fafbfcfdfeff  
Msg 6bc1bee22e409f96e93d7e117393172a  
ae2d8a571e03ac9c9eb76fac45af8e51  
30c81c46a35ce411e5fbc1191a0a52ef  
f69f2445df4f9b17ad2b417be66c3710  
Tag 47a9d0f579765bf05b2073e61313066b

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