

1 SchemeIBMETR

This scheme is only applicable to symmetric groups of prime orders.

1.1 Setup() \rightarrow (*mpk*, *msk*)

```

 $p \leftarrow \|\mathbb{G}\|$ 
generate  $g \in \mathbb{G}_1$  randomly
 $H_1 : \{0, 1\}^* \rightarrow \mathbb{G}_1$ 
 $H_2 : \{0, 1\}^* \rightarrow \mathbb{G}_2$ 
 $\hat{H} : \{0, 1\}^* \rightarrow \{0, 1\}^\lambda$ 
generate  $g_0, g_1 \in \mathbb{G}_1$  randomly
generate  $w, \alpha, t_1, t_2 \in \mathbb{Z}_p^*$ 
 $\Omega \leftarrow e(g, g)^w$ 
 $v \leftarrow g^{t_1}$ 
 $v \leftarrow g^{t_2}$ 
 $mpk \leftarrow (p, g, g_0, g_1, v_1, v_2, \Omega, H_1, H_2, \hat{H})$ 
 $msk \leftarrow (w, \alpha, t_1, t_2)$ 
return (mpk, msk)

```

1.2 EKGen(*id_S*) \rightarrow *ek_{id_S}*

```

 $ek_{id_S} \leftarrow H_1(id_S)$ 
return ekidS

```

1.3 DKGen(*id_R*) \rightarrow *dk_{id_R}*

```

generate  $r \in \mathbb{Z}_p^*$  randomly
 $dk_0 \leftarrow H_2(id_R)^\alpha$ 
 $dk_1 \leftarrow g^r$ 
 $dk_2 \leftarrow g^{-\frac{w}{t_1}} (g_0 g_1^{id_R})^{-\frac{r}{t_1}}$ 
 $dk_3 \leftarrow g^{-\frac{w}{t_2}} (g_0 g_1^{id_R})^{-\frac{r}{t_2}}$ 
 $dk_{ID_R} \leftarrow (dk_0, dk_1, dk_2, dk_3)$ 
return dkidR

```

1.4 TKGen(*id_R*) \rightarrow *tk_{id_R}*

```

generate  $k \in \mathbb{Z}_p^*$  randomly
 $tk_1 \leftarrow g^k$ 
 $tk_2 \leftarrow g^{\frac{1}{t_1}} (g_0 g_1^{id_R})^{-\frac{k}{t_1}}$ 
 $tk_3 \leftarrow g^{\frac{1}{t_2}} (g_0 g_1^{id_R})^{-\frac{k}{t_2}}$ 
 $tk_{ID_R} \leftarrow (tk_1, tk_2, tk_3)$ 
return tkidR

```

1.5 Enc(*ek_{id_S}*, *id_{Rev}*, *m*) \rightarrow *ct*

```

generate  $s_1, s_2, \beta \in \mathbb{Z}_p^*$  randomly
 $s = s_1 + s_2$ 
 $R = \Omega^{-s}$ 
 $T \leftarrow g^\beta$ 

```

$K \leftarrow e(H_2(id_{Rev}), ek_{id_S} \cdot T)$
 $ct_0 \leftarrow \hat{H}(R) \oplus \hat{H}(K) \oplus m$
 $ct_1 \leftarrow (g_0 g_1^{id_{Rev}})^s$
 $ct_2 \leftarrow v_1^{s_1}$
 $ct_3 \leftarrow v_2^{s_2}$
 $e(g, g)^s$
 $ct \leftarrow (ct_0, ct_1, ct_2, ct_3, T, V)$
return ct

1.6 Dec($dk_{id_R}, id_{Rev}, id_{Snd}, ct$) $\rightarrow m$

$R' \leftarrow e(dk_1, ct_1) \cdot e(dk_2, ct_2) \cdot e(dk_3, ct_3)$
 $K' \leftarrow e(dk_0, H_1(id_{Snd})) \cdot e(H_2(id_R), T)$
 $m \leftarrow ct_0 \oplus \hat{H}(R') \oplus \hat{H}(K')$
return m

1.7 TVerify(tk_{id_R}, ct) $\rightarrow y, y \in \{0, 1\}$

return $V = e(tk_1, ct_1) \cdot e(tk_2, ct_2) \cdot e(tk_3, ct_3)$