data:

$$\boldsymbol{S_k^{gl}}, \boldsymbol{S_k^{gu}} \ \ \forall k \in G$$
$$\boldsymbol{S_l^{cl}}, \boldsymbol{S_l^{cu}} \ \ \forall l \in C$$
$$\boldsymbol{c}_{2k}, \boldsymbol{c}_{1k}, \boldsymbol{c}_{0k} \ \ \forall k \in G$$
$$\boldsymbol{a}_l, \boldsymbol{b}_l, \boldsymbol{c}_l \ \ \forall l \in C$$
$$\boldsymbol{v_i^l}, \boldsymbol{v_i^u} \ \ \forall i \in N$$
$$\boldsymbol{v_i^l}, \boldsymbol{v_i^u} \ \ \forall i \in N_{dc}$$
$$\boldsymbol{S_i^d}, \boldsymbol{Y_i^s} \ \ \forall i \in N$$
$$\boldsymbol{P_i^d}, \boldsymbol{Y_i^s} \ \ \forall i \in N_{dc}$$
$$\boldsymbol{Y}_{ij}, \boldsymbol{b_{ij}^c}, \boldsymbol{T}_{ij} \ \ \forall (i,j) \in E$$
$$\boldsymbol{Y}_{ij} \ \ \forall (i,j) \in E_{dc}$$
$$\boldsymbol{s_{ij}^u}, \boldsymbol{\theta_{ij}^{\Delta l}}, \boldsymbol{\theta_{ij}^{\Delta u}} \ \ \forall (i,j) \in E$$
$$\boldsymbol{p_{ij}^u} \ \ \forall (i,j) \in E_{dc}$$
$$\boldsymbol{r}$$
$$p_{dc} \tag{1}$$

variables:

$$S_k^g \ \ \forall k \in G$$
$$S_l^c \ \ \forall l \in C$$
$$P_l^{c,dc} \ \ \forall l \in C$$
$$V_i \ \ \forall i \in N$$
$$V_i \ \ \forall i \in N_{dc}$$
$$S_{ij} \ \ \forall (i,j) \in E \cup E^R$$

minimize:
$$\sum_{k \in G} \boldsymbol{c}_{2k} (\Re(S_k^g))^2 + \boldsymbol{c}_{1k} \Re(S_k^g) + \boldsymbol{c}_{0k} \tag{2}$$

subject to:
$$\angle V_{\boldsymbol{r}} = 0 \tag{3}$$
$$\boldsymbol{S_k^{gl}} \leq S_k^g \leq \boldsymbol{S_k^{gu}} \ \ \forall k \in G \tag{4}$$
$$\boldsymbol{v_i^l} \leq |V_i| \leq \boldsymbol{v_i^u} \ \ \forall i \in N \tag{5}$$
$$\sum_{k \in G_i} S_k^g + \sum_{l \in C_i} S_l^c - \boldsymbol{S_i^d} - \boldsymbol{Y_i^s} |V_i|^2 = \sum_{(i,j) \in E_i \cup E_i^R} S_{ij} \ \ \forall i \in N \tag{6}$$
$$S_{ij} = \left(\boldsymbol{Y_{ij}^*} - \boldsymbol{i} \frac{\boldsymbol{b_{ij}^c}}{2} \right) \frac{|V_i|^2}{|\boldsymbol{T}_{ij}|^2} - \boldsymbol{Y_{ij}^*} \frac{V_i V_j^*}{\boldsymbol{T}_{ij}} \ \ \forall (i,j) \in E \tag{7}$$
$$S_{ji} = \left(\boldsymbol{Y_{ij}^*} - \boldsymbol{i} \frac{\boldsymbol{b_{ij}^c}}{2} \right) |V_j|^2 - \boldsymbol{Y_{ij}^*} \frac{V_i^* V_j}{\boldsymbol{T_{ij}^*}} \ \ \forall (i,j) \in E \tag{8}$$
$$|S_{ij}| \leq \boldsymbol{s_{ij}^u} \ \ \forall (i,j) \in E \cup E^R \tag{9}$$
$$\boldsymbol{\theta_{ij}^{\Delta l}} \leq \angle (V_i V_j^*) \leq \boldsymbol{\theta_{ij}^{\Delta u}} \ \ \forall (i,j) \in E \tag{10}$$
$$\boldsymbol{S_l^{cl}} \leq S_l^c \leq \boldsymbol{S_l^{cu}} \ \ \forall l \in C \tag{11}$$
$$\sum_{k \in G_i} P_k^g + \sum_{l \in C_i} P_l^{c,dc} - \boldsymbol{P_i^d} - \boldsymbol{Y_i^s} |V_i|^2 = \sum_{(i,j) \in E_{i,dc} \cup E_{i,dc}^R} P_{ij} \ \ \forall i \in N_{dc} \tag{12}$$
$$P_{ij} = p_{dc} \boldsymbol{Y}_{ij} \cdot (V_i^2 - V_i V_j) \ \ \forall (i,j) \in E_{dc} \tag{13}$$
$$|P_{ij}| \leq \boldsymbol{p_{ij}^u} \ \ \forall (i,j) \in E_{dc} \cup E_{dc}^R \tag{14}$$
$$P_l^c + P_l^{c,dc} = a + b|I_l^c| + c|I_l^c|^2 \ \ \forall l \in C \tag{15}$$
$$|V_i|^2 |I_l^c|^2 = (S_l^c)^2 \ \ \forall l \in C_i \ \ \forall i \in N \tag{16}$$
$$\tag{17}$$