MODULE $malgtd1ex3$

EXTENDS $Integers$, TLC, $Naturals$
CONSTANTS UND, $x10$, $x20$, $maxi$, $mini$
VARIABLES $x1$, $x2$, $y1$, $y2$, $y3$, $z1$, $z2$, pc

ASSUME $x10 \in Nat \land x20 \in Nat \land x20 \neq 0$
$labels \triangleq \{\text{"START"}, \text{"LOOP"}, \text{"HALT"}\}$

$Init \triangleq$
$\land pc = \text{"START"}$
$\land x1 = x10 \land x2 = x20$
$\land y1 = UND \land y2 = UND \land y3 = UND$
$\land z1 = UND \land z2 = UND$

$y1 \in min \,..\, max \land y2 \in min \,..\, max \land y3 \in min \,..\, max \land z1 \in min \,..\, max \land z2 \in min \,..\, max$

$start\_loop \triangleq$
$\land pc = \text{"START"}$
$\land pc' = \text{"LOOP"}$
$\land y1' = 0 \land y2' = 0 \land y3' = x1$
$\land$ UNCHANGED $\langle z1, z2, x1, x2\rangle$

$loop\_loop \triangleq$
$\land pc = \text{"LOOP"} \land y3 \neq 0$
$\land y1' =$ IF $y2 + 1 = x2$ THEN $y1 + 1$ ELSE $y1$
$\land y2' =$ IF $y2 + 1 = x2$ THEN 0 ELSE $y2 + 1$
$\land y3' = y3 - 1$
$\land$ UNCHANGED $\langle pc, x1, x2, z1, z2\rangle$

$loop\_halt \triangleq$
$\land pc = \text{"LOOP"} \land pc' = \text{"HALT"} \land y3 = 0$
$\land z1' = y1 \land z2' = y2$
$\land$ UNCHANGED $\langle x1, x2, y1, y2, y3\rangle$

$Over \triangleq$
$\land pc = \text{"HALT"} \land PrintT(z1) \land PrintT(z2)$
$\land$ UNCHANGED $\langle pc, x1, x2, y1, y2, y3, z1, z2\rangle$

$next \triangleq start\_loop \lor loop\_loop \lor loop\_halt \lor Over$

$safety1 \triangleq pc = \text{"HALT"} \Rightarrow 0 \leq z2 \land z2 < x2 \land x1 = z1 * x2 + z2 \land x1 = x10 \land x2 = x20$

$D \triangleq mini \,..\, maxi$

$DD(X) \triangleq (X \neq UND \Rightarrow X \in D)$

$safety2 \triangleq DD(y1) \land DD(y2) \land DD(y3) \land DD(z1) \land DD(z2)$

$question \triangleq pc \neq$ "LOOP"

$test \triangleq question$