To show:
$1 \leq y + 2 * ((y * -1 + 1)/2)$ is equivalent to (y `mod` $2 = 1$), for y being an unsigned int according to C language semantics.
We require two axioms from the C language semantics: As y is unsigned, $-y = \texttt{MAXINT} - y$. In addition, unsigned `MAXINT + 1 = 0`.
y can be an odd or even number.

(Case 1) Assume y is an odd number:

$$\frac{y * -1 + 1}{2} = \left\lfloor \frac{-y + 1}{2} \right\rfloor \tag{1}$$
$$= \left\lfloor \frac{\texttt{MAXINT} - y + 1}{2} \right\rfloor \tag{2}$$
$$= \frac{\texttt{MAXINT} - y}{2} \tag{3}$$
$$\tag{4}$$

Using this, we can show that

$$1 \leq y + 2 * \frac{y * -1 + 1}{2} \tag{5}$$
$$\Leftrightarrow 1 \leq y + 2 * \frac{\texttt{MAXINT} - y}{2} \tag{6}$$
$$\Leftrightarrow 1 \leq \texttt{MAXINT} \tag{7}$$
$$\Leftrightarrow true \tag{8}$$
$$\Leftrightarrow y \texttt{ mod } 2 = 1 \tag{9}$$

(Case 2) Assume y is an even number:

$$\frac{y * -1 + 1}{2} = \left\lfloor \frac{-y + 1}{2} \right\rfloor \tag{10}$$
$$= \left\lfloor \frac{\texttt{MAXINT} - y + 1}{2} \right\rfloor \tag{11}$$
$$= \frac{\texttt{MAXINT} - y + 1}{2} \tag{12}$$
$$\tag{13}$$

Using this, we can show that

$$1 \leq y + 2 * \frac{y * -1 + 1}{2} \tag{14}$$
$$\Leftrightarrow 1 \leq y + 2 * \frac{\texttt{MAXINT} - y + 1}{2} \tag{15}$$
$$\Leftrightarrow 1 \leq \texttt{MAXINT} + 1 \tag{16}$$
$$\Leftrightarrow 1 \leq 0 \tag{17}$$
$$\Leftrightarrow false \tag{18}$$
$$\Leftrightarrow y \texttt{ mod } 2 = 1 \tag{19}$$

$\square$