Cyclic loading of mechanical components promotes the formation of dislocation dipoles in metals, which can serve as precursors to crack nucleation and ultimately lead to failure. In the laboratory setting, an acoustic nonlinearity parameter has been assessed as an effective indicator for characterizing the progression of fatigue damage precursors. However, the need to use monochromatic waves of medium-to-high acoustic energy has presented a constraint, making it problematic for use in field applications. This paper presents a potential approach for field measurement of acoustic nonlinearity by using general purpose ultrasonic pulser-receivers. Nonlinear ultrasonic measurements during fatigue testing were analyzed by the using pulse-echo method, and matched filters were utilized to extract the fundamental and second harmonic waves from the signals, which were measured using wideband contact transducers. As in the case of the classic harmonic generation, the nonlinearity parameter indicates a strong correlation with fatigue cycles. Consideration has been given to potential nonlinearities in the measurement system, and tests have confirmed that measured second harmonic signals exhibit a linear dependence on the input signal strength, further affirming the conclusion that this parameter relates to damage precursor formation from cyclic loading.