

“Sunflower” OKO M4

The Sunflower is a standalone self-powered initializer. Use cases include hand, remote, and area denial mining.

The Sunflower is a device tuned to detect changes in its surrounding magnetic field. The Sunflower device, upon detection of a variation in the surrounding magnetic field, the size and intensity of which is programmable, will initiate a continuous current exceeding 1 Amp for a time in excess of 2 milli-seconds. This current is directed to a electronic match or igniter.

The Sunflower is designed to maximize operator/user safety. Safety measures center around avoiding unexpected initialization by usage of a progressive state machine. The state machine states must be traversed in sequence. The completion of all states terminates with the final discharge state. The state machine is presented as part of this document in Appendix A.

The Sunflower can detect infantry at a distance of up to ≈ 0.75 meters and light vehicles moving at speeds up to 60 km/h at a distance of up to ≈ 2.75 meters. These distances are based on testing, but may vary (increase or decrease) depending on how ferrous the object is, and the speed at which it is travelling. The detection algorithm also incorporates immunity to vibration to reduce the chance of misfiring due to nearby explosions and vibrations.

The Sunflower has two self-destruct functions, one, which is time based, and another based on critical low battery detection. Once the Sunflower reaches the “Ready to Fire” State (see Appendix A), the self-destruct timer begins. The default time for self-destruction is 17 days (for version M4 2032) and 62 days (for version M4 2477). The Sunflower continuously reads the mounted battery’s voltage and will self-destruct if critical low battery is detected. The self-destruct function is intended to prevent capture and reverse engineering of the Sunflower as well as the reduction of unexploded ordnance threats.

The Sunflower uses a USB type micro-B connector for programming via an Android application (version 8.0 +). To do so, users must be equipped with an OKO Programming board to connect to the Sunflower. Parameters such as the Sunflower’s magnetic field sensitivity, self-destruction timer, safety timer, and optional “Delay Before Fire” function can be adjusted to user needs.

Operational Sequence (states)

- 1) State 10 – immediately after Power ON
 - a. Green LED – Slow Blink. Red LED – OFF. Yellow LED – OFF.
 - b. Steady state (T1) timer starts, and once the timer expires, it moves into STATE 20.
 - c. This is the only function in this state.
 - d. A blinking Yellow LED is indication of low battery. Please replace the battery.
- 2) State 11 – Low Battery Self Destruction
 - a. Green LED – OFF. Red LED – OFF. Yellow LED – Solid ON.
 - b. When Critical Low Battery is Detected on Power ON, the device will enter State 11.
 - c. After 30 seconds of the Solid Yellow LED, the Red LED will begin to Fast Blink for 30 seconds, similarly to the “Last Warning” in State 30.

- d. After being Powered ON for 60 seconds, the unit will transition directly to State 50 and fire without delay.
- 3) State 20 – Collecting Steady State Data
 - a. Green LED – OFF. Red LED – Slow Blink. Yellow LED – OFF.
 - b. In this state, initial magnetometer data is collected to set the steady state. Initial data collection requires 3 uninterrupted seconds.
 - c. The T1 Timer is restarted
- 4) State 30 – Checking for Steady State
 - a. Green LED – OFF. Red LED – Slow Blink. Yellow LED – OFF.
 - b. In this state, the magnetic field is monitored, making sure the board is in the steady state.
 - c. In this state, if the Initializer is either moved or detects a change in the magnetic field, it will reset the steady state timer and return to the start of STATE 10.
 - d. The Red LED will begin to fast blink when 30 seconds remain in this state. This is indication of the “Last Warning” before being armed.
 - e. If there are no changes detected in the magnetic field and the T1 timer expires, the Initializer enters STATE 40.
- 5) State 40 – Ready to Fire
 - a. All LED’s – OFF.
 - b. IMPORTANT – The Self Destruct Timer Starts. The device will self liquidate once T_{TOT} is reached.
 - c. This is an armed state, and there is no way to safely disarm the device. Once this state is reached, any changes in magnetic field triggers an explosion. Changes in magnetic field also occur when the device is moved, so any slight movement will cause the Initializer to transition to STATE 50.
- 6) State 41 – Delay Before Fire
 - a. An optional delay before the initializer fires. The Default delay is 0, and the units are in milliseconds.
 - b. This function only occurs if P1 is reached for S1, otherwise it will not be used.
- 7) State 50 – Explode

Power On

The Sunflower is equipped with a manual switch. The manual switch is depressed by a red plastic tab that has a looped string attached to it. The manual switch is engaged by pulling/removing the plastic tab from the unit.

The plastic tab string is intended as a pull point. Use cases such as remote deployment/mining can be conducted by attaching the plastic tab string to the drone so that the Sunflower is powered-on as it is being dropped. This ensures higher degree of safety for the user.

Yellow LED

During Power On, if the Yellow LED blinks, this indicates a low battery warning. It is highly recommended to replace the Sunflower’s battery. If the Yellow LED is Solid On, this indicates a critical low battery state has been detected before the Sunflower has transitioned into State 40. “Low Battery Self Destruction” will initiate and the Sunflower will self liquidated in 60 seconds unless powered off.

Self Destruct

As mentioned previously the Sunflower includes a self-destruct timer that is started in State 40. The T_{TOT} Parameter is by default 408 hours (17 days) for the M4 2032 (smaller battery), and 1488 hours (62 days) for the M4 2477 (bigger battery). If the time is set to 0 minutes, the device will self destruct/fire immediately upon reaching The “Ready to Fire” (State 40). While reprogramming the Sunflower, remember to review parameter B2 to ensure proper units are selected for your use case (minutes/hours). The default unit for parameter B2 is hours.

The Sunflower also continuously reads the mounted battery’s voltage. If critical low battery is detected in State 10, the device will flash the appropriate sequence of warning LED’s and begin it’s self-destruct sequence, exploding in 60 seconds. If critical low battery is detected in State 40, the device will self-destruct without delay or any LED indication (as it is in the “Ready to Fire” State). The self-destruction function cannot be disabled.

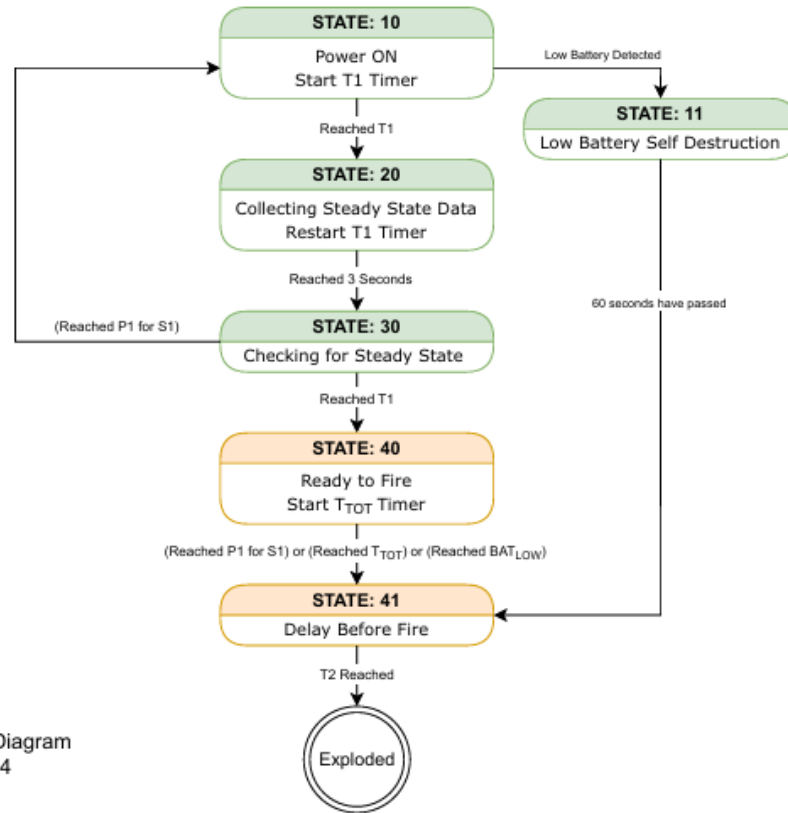
Sensitivity Parameters

The sensitivity can be adjusted by changing the P1/S1 parameters. The P1 parameter is the magnetic field sensitivity. A higher P1 value will result in a lower sensitivity, meaning ferrous objects must be in closer proximity to trigger the device. The S1 parameter indicates the amount of consecutive readings of detected magnetic field change above the threshold. A larger S1 will result in a lower sensitivity for faster moving objects. It is highly recommended to consult with OKO Systems if users plan to adjust the sensitivity parameters.

Adjusting Parameters

Parameters can be configured and adjusted using the Android App OKO-M4. To do so, users must be equipped with a reusable OKO Programming board to connect to the Sunflower.

Appendix A



M4.7 Initializer State Diagram
Firmware Version: 1.04
November 7, 2024

Parameter	Unit	Description	Default	Min:Max
T _{TOT}	Hours	Self Destruct Timer	Note 4	0:65535
T1	Minutes	Steady State Timeout	5	1:15
P1		Sensitivity	40	0:200
S1	# of Samples	Consecutive Hits Above Threshold	4	1:8
T2	Seconds	Last Warning - LED Fast Blink Duration	30	10:30
T3	Milliseconds	Delay Before Fire	0	0:65535
B2	bool	Change T _{TOT} unit from Minutes to Hours	1	0:1

Status LED's			
State	Green LED	Red LED	Yellow LED
Config	1 Blink then Pause	OFF	OFF
10	Slow Blink	OFF	Note 1
11	OFF	Note 3	Note 3
20	OFF	Slow Blink	OFF
30	OFF	Note 2	OFF
40	OFF	OFF	OFF
41	OFF	OFF	OFF

Note 1: Yellow LED will be displayed if BAT_{WARN} is reached

Note 2: The Red LED will slow blink until 30 seconds remain in State 30, in which case it will begin to fast blink to signify last warning before activation.

Note 3: In State 11, the Yellow LED will be solid for 30 seconds, then the Red LED will fast blink for 30 seconds, indicating self destruction.

Note 4: The Self Destruct Timer Default is 408 (17 days) for the M4 2032, and 1488 (62 days) for the M4 2477