

Field-Adjusted Leveling Accuracy

AG808 GNSS Land Leveling System

Report No.	AG808-TR-2024-01
Test Date	19 March 2024 08:40-12:15
Test Engineer	Tom
Status	Draft validation report - example dataset
Prepared for	Toway Technology (Shanghai) Co., Ltd.

Publication control: The numerical results in this draft are example values created to demonstrate a technically coherent GNSS/RTK validation report structure. Replace them with traceable field records before publication or customer distribution.

Document control

Revision	A	Issue date	23 Sep 2026
Reviewed by	-	Approved by	-

1. Objective

To verify AG808 field-adjusted relative elevation performance under open-sky RTK conditions using an independent vertical reference. The evaluated target is +/-25 mm for field leveling after local calibration.

2. Test configuration

Test site	Open agricultural field; firm, dry soil; low surrounding obstruction.
Ambient conditions	16-22 deg C; wind below 3 m/s; dry weather.
Base-to-rover distance	Approx. 2.4 km.
GNSS acceptance	RTK FIX only; PDOP 1.2-1.8; typical correction age below 2 s.
Reference	Closed-loop digital leveling from a fixed local benchmark; selected checkpoints cross-checked with a total station.
Sample	60 independent checkpoints distributed across high, low and transitional areas of the field.

3. Equipment and records

- AG808 GNSS land leveling controller and GNSS antenna set.
- RTK base station with surveyed local position.
- Digital level, staff and local elevation benchmark.
- Total station for selected independent cross-checks.
- Field log recording time, RTK state, PDOP, correction age and observed elevation for each accepted checkpoint.

4. Test procedure

1. Establish the reference benchmark and close the digital-level loop to confirm vertical control consistency.
2. Configure the RTK base station and confirm correction transmission and fixed-solution availability at the rover.
3. Perform the AG808 local field calibration using the designated control elevation.
4. Observe 60 distributed checkpoints. Accept a checkpoint only after the rover reports a stable RTK fixed solution.
5. Compare AG808 adjusted elevation with the independent reference elevation at the same checkpoint.
6. Calculate residual, mean bias, RMSE and percentage of checkpoints within +/-25 mm.

5. Example result summary

Metric	Example value	Acceptance / interpretation
Accepted checkpoints	60	All checkpoints met RTK FIX acceptance condition
Within +/-25 mm	58 / 60 (96.7%)	Consistent with field-level target for this example dataset
Vertical RMSE	16.8 mm	Relative to independent field reference
Mean vertical bias	+1.8 mm	Low systematic offset after local calibration
Maximum absolute residual	29.4 mm	Two example checkpoints exceed +/-25 mm

6. Data interpretation

Residual definition: AG808 adjusted elevation minus independent reference elevation. RMSE is calculated from all accepted checkpoint residuals. The result represents relative field-leveling performance after local calibration, not absolute geodetic orthometric height accuracy.

7. Conclusion

In this example dataset, 96.7% of accepted checkpoints fall within +/-25 mm of the independent field reference, with a vertical RMSE of 16.8 mm. This supports the intended +/-2.5 cm field-adjusted leveling performance under open-sky, short-baseline, stable RTK FIX conditions.

Technical notes

- Do not combine this result with the 30 km coverage claim. Long-baseline correction availability and centimeter-class leveling performance are separate validations.
- Potential error sources include antenna-height error, base coordinate error, satellite geometry, multipath, correction latency, local calibration quality and machine dynamics.
- Publish only after replacing the example results with traceable field logs, raw observations and reference survey records.

8. Sign-off

Test Engineer	Tom
Signature	_____
Date	_____

Automatic Terrain Calibration Validation

AG808 GNSS Land Leveling System

Report No.	AG808-TR-2024-02
Test Date	28 May 2024 13:20-17:40
Test Engineer	Tom
Status	Draft validation report - example dataset
Prepared for	Toway Technology (Shanghai) Co., Ltd.

Publication control: The numerical results in this draft are example values created to demonstrate a technically coherent GNSS/RTK validation report structure. Replace them with traceable field records before publication or customer distribution.

Document control

Revision	A	Issue date	23 Sep 2026
Reviewed by	-	Approved by	-

1. Objective

To quantify the change in elevation residuals before and after AG808 automatic terrain calibration using the same field, checkpoints and independent reference surface. The evaluated claim is an improvement of up to 20% under suitable terrain and calibration conditions.

2. Test configuration

Test site	Slightly undulating agricultural field; approx. 6.8 ha; approx. 1.3 m total elevation relief.
Ambient conditions	24-29 deg C; dry surface; open sky; low multipath exposure.
Base-to-rover distance	Approx. 4.1 km.
GNSS acceptance	RTK FIX during accepted samples; PDOP 1.3-2.1.
Reference surface	Independent elevation model derived from surveyed control points using digital leveling and total-station observations.
Sample	84 reference checkpoints, reused in both pre-calibration and post-calibration analysis.

3. Experimental design

- Use identical checkpoints for both datasets to prevent sampling bias.
- Keep base station, GNSS antenna configuration and reference surface unchanged.
- Calculate residuals against the same independent elevation model.
- Report RMSE before calibration, RMSE after calibration and percentage improvement.

4. Test procedure

1. Survey the independent control network and generate the reference terrain surface.
2. Collect AG808 checkpoint elevations using the initial field calibration.
3. Run AG808 automatic terrain calibration using the designated field calibration workflow.
4. Repeat observations at the same 84 checkpoints under stable RTK FIX conditions.
5. Calculate pre-calibration and post-calibration residuals against the same reference surface.
6. Compute percentage improvement as $(RMSE_before - RMSE_after) / RMSE_before \times 100\%$.

5. Example result summary

Metric	Before calibration	After calibration	Change
Checkpoint count	84	84	Same sample
Vertical RMSE	31.2 mm	25.0 mm	19.9% lower
Mean absolute error	25.7 mm	20.4 mm	20.6% lower
Mean bias	+7.4 mm	+2.9 mm	Reduced systematic offset
RTK FIX acceptance	100%	100%	No change in sample rule

6. Calculation

RMSE improvement = $(31.2 - 25.0) / 31.2 \times 100\% = 19.9\%$.

7. Conclusion

The example paired-checkpoint analysis shows a 19.9% reduction in vertical RMSE after automatic terrain calibration. The result is consistent with an "up to 20%" improvement claim for the tested terrain and initial calibration condition, but should not be generalized as a guaranteed improvement for every field.

Technical notes

- Improvement should always be calculated from the same checkpoints and reference surface before and after calibration.
- A field that is already well calibrated may show much less improvement.
- Terrain relief, checkpoint distribution, control quality, implement geometry and GNSS conditions can materially change the result.

8. Sign-off

Test Engineer	Tom
Signature	
Date	

30 km RTK Base Coverage Validation

AG808 GNSS Land Leveling System

Report No.	AG808-TR-2024-03
Test Date	16 August 2024 09:00-18:10
Test Engineer	Tom
Status	Draft validation report - example dataset
Prepared for	Toway Technology (Shanghai) Co., Ltd.

Publication control: The numerical results in this draft are example values created to demonstrate a technically coherent GNSS/RTK validation report structure. Replace them with traceable field records before publication or customer distribution.

Document control

Revision	A	Issue date	23 Sep 2026
Reviewed by	-	Approved by	-

1. Objective

To evaluate correction-link availability, RTK fixed-solution availability and re-initialization behavior at increasing base-to-rover distances up to 30 km. This test validates communication and RTK usability range; it is not a 30 km leveling-accuracy certification.

2. Test configuration

Test corridor	Open rural corridor with predominantly flat terrain and clear sky visibility.
Ambient conditions	29-35 deg C; dry weather; low observed RF interference.
Base setup	Base correction antenna installed at an elevated open location with stable power.
Distances	5, 10, 15, 20, 25 and 30 km.
Sessions	3 independent restart/re-initialization sessions per distance; 18 sessions total.
Reference	Previously surveyed control positions used to confirm repeatable rover setup at each station.

3. Coverage metrics

- Correction-link availability: percentage of observation time with valid correction stream.
- RTK FIX availability: percentage of valid observation time with fixed integer solution.
- Re-fix time: elapsed time from restart to stable RTK FIX.
- Correction age: age of correction data received by the rover.
- Session completion: whether the system achieved and maintained the required state for the planned observation interval.

4. Test procedure

1. Initialize the base station and verify the correction service near the base.
2. Move the rover to each surveyed distance station.
3. At each distance, perform three independent restart cycles to avoid reporting a single favorable initialization.
4. Log correction status, RTK state, correction age and time-to-fix for each session.
5. Calculate availability statistics by distance and separately report the 30 km station.

5. Example result summary

Baseline	Correction link	RTK FIX availability	Median re-fix time
5 km	99.9%	99.7%	3.1 s
10 km	99.8%	99.5%	3.8 s
15 km	99.6%	99.1%	4.6 s
20 km	99.3%	98.8%	5.4 s
25 km	98.8%	97.9%	6.9 s
30 km	98.1%	96.3%	8.6 s

6. Interpretation

Coverage claim: The example result supports operation of the correction link and repeated RTK fixed-solution recovery at a 30 km baseline under the stated open, low-interference conditions.

Accuracy limitation: Do not state or imply that the same +/-2.5 cm field-leveling performance is guaranteed at 30 km. GNSS uncertainty and atmospheric decorrelation generally increase as baseline length increases.

7. Conclusion

The example dataset shows successful correction reception at all planned stations up to 30 km. At the 30 km station, example correction-link availability is 98.1%, RTK FIX availability is 96.3%, and median re-fix time is 8.6 s. These values support a 30 km base-coverage statement only for comparable environmental and communications conditions.

Technical notes

- Actual range depends on terrain, antenna height, RF interference, correction transmission method, local regulations, atmospheric conditions and obstructions.
- For a production report, include transmitter power, antenna model/height, frequency/service type, data-link configuration and raw session logs.
- If correction transport is via cellular/NTRIP rather than local radio, describe network coverage separately from GNSS baseline effects.

8. Sign-off

Test Engineer	Tom
Signature	
Date	

Field Productivity and Operating Cost Study

AG808 GNSS Land Leveling System

Report No.	AG808-TR-2024-04
Test Date	11-23 November 2024
Test Engineer	Tom
Status	Draft validation report - example dataset
Prepared for	Toway Technology (Shanghai) Co., Ltd.

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Revision	A	Issue date	23 Sep 2026
Reviewed by	-	Approved by	-

1. Objective

To compare direct field operating cost and workflow efficiency for AG808-assisted land leveling against a conventional survey-and-grade workflow under paired field conditions. The evaluated marketing range is 30-50% potential direct operating-cost reduction.

2. Study configuration

Study period	11-23 November 2024.
Sites	Four post-harvest farms with dry, workable soil.
Sample	8 paired field sections; approx. 52.6 ha total evaluated area.
Pairing principle	Adjacent or comparable sections matched for initial slope, soil condition and expected earthwork where practical.
Equipment control	Same tractor class and comparable scraper configuration maintained between paired sections where practical.
Cost basis	Fuel, operator labor, setup/survey labor, grade checking, machine hours and corrective/rework passes; normalized per hectare.

3. Cost categories

- Initial survey and setup labor.
- Grade-setting and checking time.
- Tractor/scraper machine hours.
- Fuel consumption.
- Operator labor.
- Corrective passes and rework.
- Final re-checking and acceptance activities.

Excluded from the example direct operating-cost comparison: capital purchase price, financing, depreciation, insurance and tax effects unless specifically included in the farm accounting model.

4. Study procedure

1. Document baseline field condition and intended target grade for each paired section.
2. Run the conventional workflow on one section and AG808-assisted workflow on the matched section.
3. Record labor hours, machine hours, fuel, grade-check activities and corrective passes.
4. Normalize direct operating cost per hectare for each section.
5. Calculate saving percentage as $(\text{Conventional cost} - \text{AG808 cost}) / \text{Conventional cost} \times 100\%$.
6. Report the range and median across paired sections rather than relying on a single best case.

5. Example paired-section summary

Pair	Area	Conventional cost index	AG808 cost index	Reduction
A	5.8 ha	100	68.4	31.6%
B	6.2 ha	100	64.9	35.1%
C	7.1 ha	100	60.8	39.2%
D	6.4 ha	100	62.1	37.9%
E	5.9 ha	100	57.4	42.6%

Pair	Area	Conventional cost index	AG808 cost index	Reduction
F	7.0 ha	100	61.6	38.4%
G	6.8 ha	100	53.8	46.2%
H	7.4 ha	100	59.7	40.3%

6. Example aggregate result

Observed example reduction range	31.6-46.2%
Median example reduction	38.8%
Primary example drivers	Reduced setup/checking time, fewer manual grade checks and fewer corrective passes.

7. Conclusion

The example paired-field dataset falls within the 30-50% direct operating-cost reduction range. The result should be presented as potential savings under the tested workflow, not as a guaranteed return for every farm or project.

Technical notes

- Cost comparisons should state local labor and fuel assumptions in the production report.
- Fields with little rework under the baseline method may show smaller savings.
- Fields with difficult survey logistics, many grade checks or repeated corrective passes may show larger differences.
- If ROI or payback is published later, capital equipment cost and utilization assumptions must be added explicitly.

8. Sign-off

Test Engineer	Tom
Signature	_____
Date	_____