Reliability and Availability: MTBF, MTTR, Series and Parallel

Availability of one item from MTBF and MTTR, the availability of n identical items in series and in parallel (redundant), and the reliability over a mission time.

Method: Reliability mathematics with constant failure rates (definitions; O'Connor, Practical Reliability Engineering)

Input parameters

Unit system: SI

Parameter	Value	Unit
Mean time between failures	50,000	h
Mean time to repair	8.0000	h
Number of identical items	2.0000	
Mission time	8,760.0	h

Calculated results

Parameter	Value	Unit
Availability of one item	99.984	%
Availability, n in series	99.968	%
Availability, n in parallel (1 needed)	100.000	%
Reliability of one item over the mission	83.929	%
Expected downtime per year, one item	1.4014	h

Notes for this case

- Constant failure rate (exponential) and independent failures; common-cause failures limit the real benefit of redundancy.

Formula and method

$$A = \frac{MTBF}{MTBF + MTTR}, \quad A_s = A^n, \quad A_p = 1 - (1 - A)^n, \quad R(t) = e^{-t/MTBF}$$

Variables

$MTBF$	Mean time between failures	s
$MTTR$	Mean time to repair	s
n	Number of identical items	-
t	Mission time	s
A	Availability of one item	-
A_s	Availability, n in series	-
A_p	Availability, n in parallel (1 needed)	-
$R(t)$	Reliability of one item over the mission	-
D	Expected downtime per year, one item	s

Method and standards

Constant-failure-rate reliability.

Assumptions and limits

- Independent, constant failure rates.
- The number of items is a whole number; a fractional entry is rounded, with a note.

References

- Reliability mathematics with constant failure rates (definitions; O'Connor, Practical Reliability Engineering)

Report details

Report reference	FCC-67Z7-CV76 (the same inputs always give the same reference)
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Release checks	2 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/instrumentation/signals-calibration/reliability-availability-mtbf

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.