

## INTELLIGENT PROTECTION AND DUTY CYCLE CONTROL FOR DC MOTORS OF COMPRESSORS

ET-I<sup>2</sup>t protects DC motors against thermal overload, prolonged operation and short circuits.

The device monitors motor current and calculates the I<sup>2</sup>t integral value (current squared x time) to prevent damage before overheating occurs.

An internal memory ensures that the motor operates within its permitted duty cycle (e.g. S3 25%) over a 10-minute cycle, even if the power supply is interrupted.



### KEY FEATURES

- I<sup>2</sup>t (current squared time) based thermal protection
- Duty cycle control for short time operation (e.g. S3 25%)
- Maximum continuous run time limit (adjustable, default 100 s)
- Overload and short circuit protection with latch-off
- Thermal shutdown with latch-off
- Automatic self-recovery when control signal is removed and later re-applied (see operating behavior)
- Internal non-volatile memory preserves thermal history and duty cycle state
- Adjustable current limit and allowed on-time
- Status indication: Power, Run, Trip (on request)
- Compact, robust and easy to install
- Designed for heavy duty applications and railway

### OPERATING BEHAVIOUR OVERVIEW



#### LATCH-OFF (HARD FAULTS)

- Shot circuit or shot to ground
  - Internal device fault
- Output is latched-off. Recovery only after power cycle or control reset.



#### SELF-RECOVERY (OVERLOAD, DUTY CYCLE LIMIT)

- If the motor is energized continuously, the device disconnects the output when the thermal limit or the maximum run time is reached.
- When the control signal is removed (pedal released or contactor opens), the device resets the timer and enters cool-down evaluation.
- When control signal is applied again, the motor is allowed to start automatically.
- The next allowed run time is calculated according to the stored thermal history to keep the total on-time within limits of operation mode (e.g. S3 25% over 10 minutes).

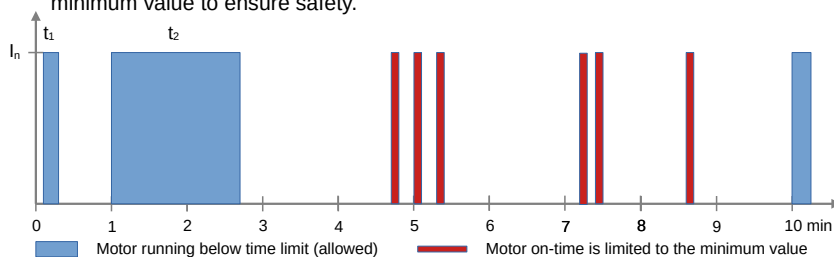


#### NORMAL OPERATION

- During normal intermittent use the device is transparent.
- No unnecessary shutdowns.

### DUTY CYCLE CONTROL (EXAMPLE: S3 25%)

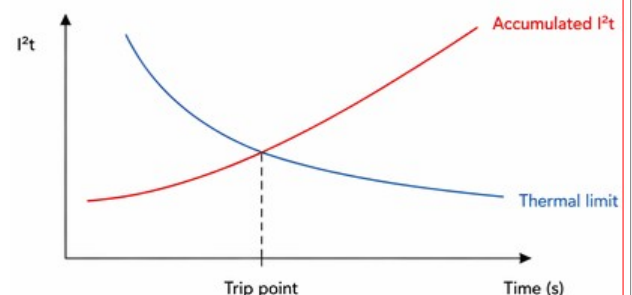
- The device ensures that the motor on-time does not exceed 25% at rated current within any 10-minute period.
- When the on-time limit is reached, the switched-on duration is limited to a minimum value to ensure safety.



**Example:** Compressor motor of the tram's sanding device is specified for S3 25% over 10 min period = 2.5 minutes on-time. After each operation, the device calculates remaining allowed on-time. During on-time  $t_2$  driver forgot his bag on sanding pedal and I<sup>2</sup>t device detected on-time limit. Only the minimum set operating time is then allowed. If more sanding is required, the pedal must be pressed repeatedly.

### I<sup>2</sup>t PRINCIPLE




I<sup>2</sup>t is the integral of the current squared over time. When the I<sup>2</sup>t value reaches the motor's thermal limit curve, the output is disconnected to prevent overheating.



### TECHNICAL DATA

Nominal voltage	8 ... 36 V DC	Duty cycle control	S3 (e.g. 25% over 10 min)
Rated current	10 A DC	Max. on-time	1...300 s (default 100 s)
Operating temperature	-40...+50°C	Overload trip	Adjustable (I <sup>2</sup> t based)
Protection class	IP65	Short circuit protection	Yes (latch-off)
Dimensions (W x H x D)	42 x 54 x 24mm (+ plugs)	Thermal shutdown	Yes (latch-off)
Mounting	screw fastening	Compliance	CE, EN 50155, EN 45545-2

### APPLICATIONS

-  Tram and LRV sanding compressors
-  DC motors in transport applications
-  Protection against stuck pedal, welded relay and overload