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Overload protection of an RCCB or switch in an LV assembly to BS EN 61439-3

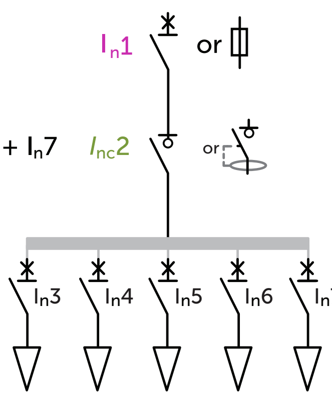
BS 7671: 2018 IET Wiring Regulations 18th Edition specifies requirements for overload protection of an RCCB or switch in an LV assembly, Regulations 536.4.3.2, 536.4.5 and 536.4.202 refer. This bulletin provides BEAMA member's guidance for RCCB and switch overload protection however; individual manufacturer's instructions must be followed, particularly the rated current of the related assembly circuit I_{nc} (A) which must be stated in the documentation supplied with the LV assembly e.g. distribution board or consumer unit.

The rated current in the assembly circuit I_{nc} (A) of the switch or RCCB shall be derived from one of the following two methods in diagrams 1 and 2. In both methods, circuits shall be designed so that a small overload of long duration is unlikely to occur.

1. Be greater than or equal to the sum of the rated current of all outgoing circuit OCPDs[1] e.g. MCBs, fuses; see diagram 1.

Diagram 1

$I_{nc}2 \geq I_n3 + I_n4 + I_n5 + I_n6 + I_n7$



$I_{nc}2$ = Rated current of a circuit (A) stated by the assembly manufacturer which may be lower than the unenclosed rated current marked on the device (switch disconnector or RCCB) due to grouping & internal enclosure temperature etc.

I_n3 to I_n7 = Rated current of outgoing protective device (A)

= Circuit-breaker

= Fuse

= Isolating switch / disconnector (without integral overload protection)

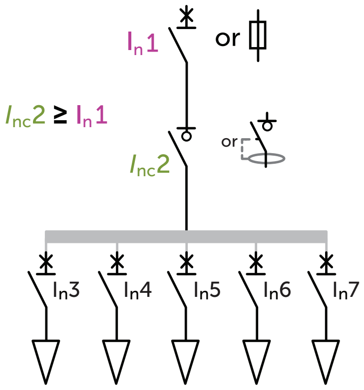
= RCCB (without integral overload protection)

I_n1 = The rated current of the overload protective device conforming to one of the following: a general-purpose type (gG) fuse to BS 88-2, a fuse to BS 88-3, a circuit-breaker to BS EN 60898, a circuit-breaker to BS EN 60947-2 or a residual current circuit-breaker with integral overcurrent protection (RCBO) to BS EN 61009-1

Note[1]. For individual circuits with load currents that are unlikely to be increased, cannot be overloaded and where spare way(s) cannot introduce a total sum exceeding the original calculated value, the installation designer may decide to use the design current of the circuit instead of the rated current of the OCPD. For a group of circuits likely to be on simultaneously e.g. electric heating, no diversity between circuits is permitted.

2. Have a rated current based upon diversity[1] and a suitably rated overload protective device conforming to one of the following: a general-purpose type (gG) fuse to BS 88-2, a fuse to BS 88-3, a circuit-breaker to BS EN 60898, a circuit-breaker to BS EN 60947-2 or a residual current circuit-breaker with integral overcurrent protection (RCBO) to BS EN 61009-1; see diagram 2.

Diagram 2



$I_{nc}2 \geq$ **$I_n3 + I_n4 + I_n5 + I_n6 + I_n7$ x % diversity**

OR

$I_{nc}2 \geq$ **$I_b3 + I_b4 + I_b5 + I_b6 + I_b7$ x % diversity**

$I_{nc}2$ = Rated current of a circuit (A) stated by the assembly manufacturer which may be lower than the unenclosed rated current marked on the device (switch disconnector or RCCB) due to grouping & internal enclosure temperature etc.

= Circuit-breaker

= Fuse

= Isolating switch / disconnector (without integral overload protection)

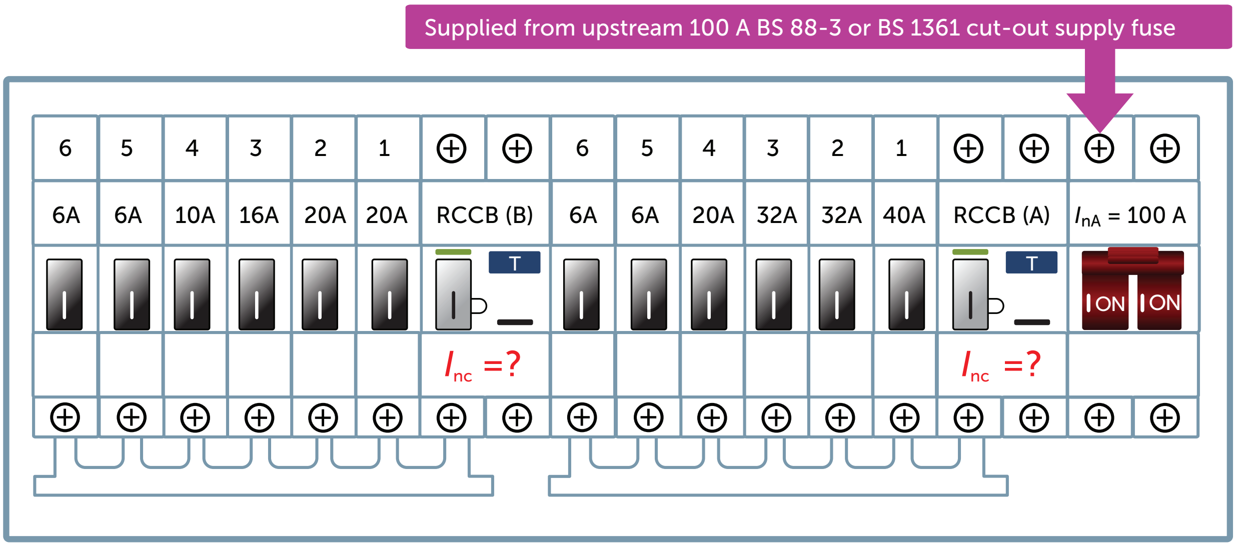
= RCCB (without integral overload protection)

I_n3 to I_n7 = Rated current of outgoing protective device (A)

I_n1 = The rated current of the overload protective device conforming to one of the following: a general-purpose type (gG) fuse to BS 88-2, a fuse to BS 88-3, a circuit-breaker to BS EN 60898, a circuit-breaker to BS EN 60947-2 or a residual current circuit-breaker with integral overcurrent protection (RCBO) to BS EN 61009-1

The following are Indicative examples of methods in diagrams 1 & 2 applied to a split-load consumer unit arrangement as illustrated in diagram 3 below.

Diagram 3 – Split-load / dual RCCB consumer unit supplying mixed standard circuits / loads



I_{nA} is the rated current of the assembly i.e. the maximum load current that it is designed to distribute.

RCCB (A) required minimum I_{nc} in the circuit of the consumer unit assembly

Step 1. Using diagram / method 1, calculate the sum of the MCBs[2] rated current (I_n) i.e.

- 40 + 32 + 32 + 20 + 6 + 6 = 136 A.

(See note 1 on page 1 in relation to using I_b *instead of* I_n*)*

Step 2. 136 A exceeds the 100 A supply fuse therefore, use diagram / method 2 applying diversity.

Step 3. Apply diagram / method 2 in two stages:

- Stage 1. Apply diversity to the group of circuits to determine a minimum rated I_{nc}, Regulation 536.4.202 refers. One method for a domestic installation could be 100% of the highest I_n plus 40% of all other i.e. 40 + (0.4 x (32 + 32 + 20 + 6 + 6)) = 78.4 A. *(See note 1 on page 1 in relation to using* I_b *instead of* I_n*)*
- Stage 2. Apply the overload coordination principle $I_{nc} \geq I_n$. The supply fuse affording overload protection is a 100 A BS 88 or BS 1361 therefore, the minimum RCCB (A) circuit I_{nc} is 100 A for overload coordination.

Conclusion

The minimum rated current I_{nc} of the circuit in the consumer unit for the RCCB (A) based upon diversity is 78.4 A. However, overload protection shall not solely be based on the use of diversity factors of the downstream circuits, see Regulation 536.4.202. **To achieve overload protection** of the RCCB circuit, the rated current of the OCPD shall be selected according to the manufacturer's instructions, which for BEAMA members, is coordinating with the upstream OCPD, in this case a 100 A fuse.

Therefore, the required minimum rated current I_{nc} in the circuit of the consumer unit for the RCCB (A) is **100 A.**

Note[2]. MCB is used as a generic term for a circuit-breaker to BS EN 60898.

RCCB (B) required minimum I_{nc} in the circuit of the consumer unit assembly

Step 1. Using diagram / method 1, calculate the sum of the MCBs[2] rated current (I_n) i.e.

- 20 + 20 + 16 + 10 + 6 + 6 = 78 A which does not exceed the 100 A supply fuse.

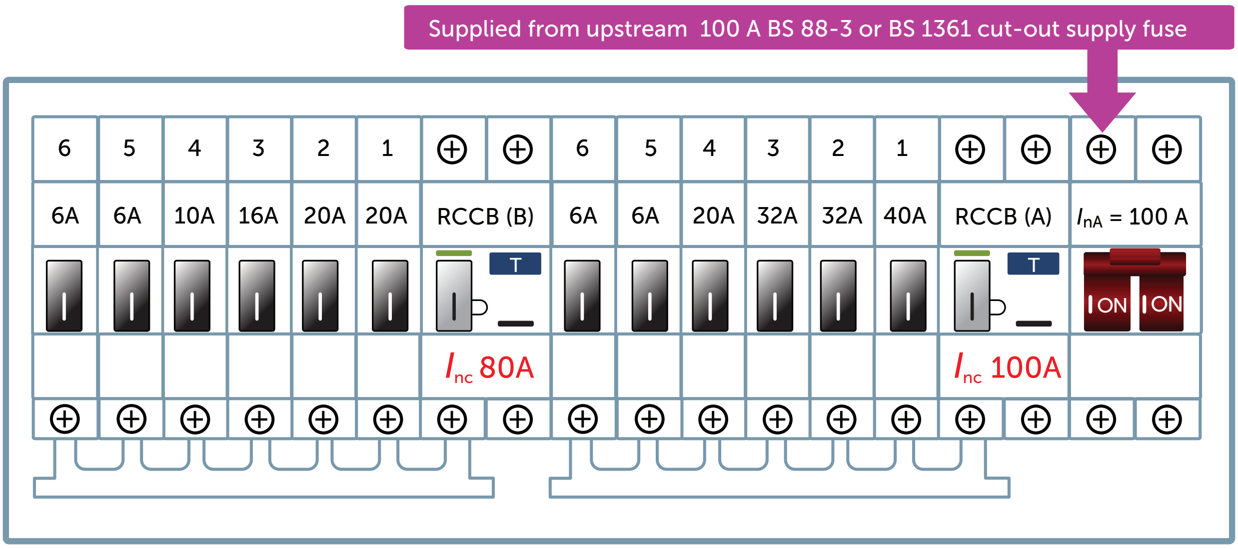
Conclusion

The required minimum rated current I_{nc} of the circuit in the consumer unit for the RCCB (B) is **78 A.** It is likely, that the rated current I_{nc} would be a standardised value of **80 A.**

Method 2 using diversity could be applied and a lower RCCB rating selected however, this would require a supplementary OCPD lower than 100 A for overload coordination with the RCCB.

Diagram 4 – Conclusion to minimum I_{nc} of the RCCB circuits in the consumer unit assembly

The methods above conclude that, for the split-load / dual RCCB consumer unit, the I_{nc} ratings of the RCCB circuits would be 80 A and 100 A as illustrated below for the mixed standard circuit configuration shown in Diagram 3.



The methods illustrated are not intended for calculating the maximum demand of the complete installation, they relate to the demand of the specific group of circuits supplied through each RCCB. One method for calculating the maximum demand of the complete domestic installation where there are mixed standard circuits, is by taking 100% of the highest I_n plus 40% of all other e.g. applying to our example above: 40 + (0.4 x (32 + 32 + 20 + 6 + 6 + 20 + 20 + 16 + 10 + 6 + 6)) = 109.6 A. The allowances for the conventional circuits are applied to I_n and engineering judgement could conclude, that given this cautious approach, a maximum demand of 100 A would be appropriate. The designer could, from knowledge and experience, reduce the 0.4 factor, the use of lower factors or other methods of determining maximum demand is not precluded where specified by a competent electrical design engineer.

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