C-Bus Application Messages & Behaviour

Chapter 7 – Trigger Control

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7 TRIGGER CONTROL APPLICATION

7.1 Application ID

$CA

Note that to ensure consistent operation of C-Bus networks, this Application ID shall not be reassigned.

7.2 Description

The Trigger Control Application is used to cause a number of actions in response to a single C-Bus message.

7.2.1 Overview

Devices that respond to Trigger Control Application Messages cause a defined set of actions to occur, one time only, each time the trigger message is received.

The actions taken are typically to emit one or more new C-Bus messages (generally on another Application), or to output information on some other medium (for example, simple Infra-Red codes to control Televisions, VCRs, etc).

For historical reasons and for compatibility with C-Bus Lighting Application commands, the commands used for the Trigger Control Application look like Lighting Application ON, OFF and Ramp to Level commands.

Each Trigger uses two numbers, known as the Trigger Group and the Action Selector.

A unit which is waiting for a Trigger message will only perform its defined action when it receives a trigger message where BOTH the Trigger Group and Action Selector match what that device expects.

7.2.2 Programmable Devices Respond to Triggers

Units that respond to Trigger Control Messages can generally be programmed in some manner, so that the exact trigger message and the actions taken can be set up at the time the device is installed.

Typical units that respond to Trigger Control Application messages are the Clipsal Scene Controller or the C-Bus Touchscreen (to set specific lighting conditions), and the Clipsal IR output unit (to control simple Infra-Red devices).

7.2.3 Triggers and Scenes

A C-Bus Scene is, at the very least, a collection of Lighting Group / Level pairs. When a scene is activated, each Lighting group in the scene is set to its stored level.

A scene can be stored in any unit, or combination of units, that have enough storage to hold the components.

Scenes can be activated either by pressing a button on the unit that stores the scene, or by a Trigger. When a button is used to activate a scene, a Trigger is also transmitted, and this is the same Trigger that remotely activates the scene. This allows a scene to be split amongst several units.

For scenes, the Trigger Group and Action Selector are used to tell one (or more) units to activate a scene they contain, if the scene's associated Trigger Group and Action Selector match those which are sent over the bus.

The choice of Trigger Group and Action Selector is important, because these numbers are also used to help work out when the Scene Indicators are ON or OFF.

7.2.3.1 Desired Behaviour for Scene Indicators

When a button has been set to activate a scene, the indicator on that button must be ON when the scene is active, and OFF when the scene is not active.

Turning the indicator on is the easy: whenever the scene is set (locally) or Triggered (remotely) the scene components are played out into the network and the indicator is turned on.

When turning the indicator off, the following rules must be followed:

- When any Lighting Group changes level, and that group is a component of an active scene, then the scene is said to be broken and the indicator is turned off;
- When another Scene is activated, and that other Scene is considered to be Mutually Exclusive, then the indicator for the currently active scene is turned off; and
- When another Scene is activated, and that other Scene is unrelated to the currently active scene, then the indicator for the currently active scene is left alone.

7.2.3.2 Trigger Conventions used for Scenes

To implement the above rules, the following convention is used:

- Scenes that share the same Trigger Group number are considered Mutually Exclusive.
- Scenes that do not share the same Trigger Group number are considered Unrelated.

Because there are 256 possible Trigger Groups, it means that in a single network there can be up to 256 unrelated scene collections. Each scene collection can contain up to 256 mutually exclusive scenes.

Any combination in any mix of Mutually Exclusive and Unrelated scenes can be used, up to the above limits.

7.2.3.3 Behaviour of a Unit when a Scene is Set

When a scene is set:

- The unit transmits the (normally Lighting) commands that make up the scene; and
- If a button was pressed on a unit to activate the scene, then that unit transmits the corresponding pre-programmed Trigger Group and Action Selector on the Control Trigger Application.

The effect of the transmission of the Trigger Group and Action Selector is twofold:

1. If there are scene components stored in some other unit, then this other unit will receive the Trigger Group and Action Selector, and if they match it will transmit its portion of the scene; and

2. If a unit has no scene components, this creates a mechanism for remotely triggering a scene (that lives somewhere else).

The converse case is where a unit receives a Trigger Group and Action Selector - in which case the scene is activated if both received numbers match those associated with a stored scene. Note that in this case though, the receiving unit does not transmit the Trigger Group and Action Selector, because there was not an associated button being pressed.

7.2.3.4 Switching Off Scene Indicators

The general conditions for controlling the indicators was described above. When any unit detects that a scene has become broken, it turns off any indicators that are on and associated with the scene that was found to be broken. The unit also transmits an Indicator Kill message. This message includes the associated Trigger Control Group (but not the Action Selector because it is not needed).

Any unit receiving an Indicator Kill message just looks up the Trigger Control Group in its list of known Trigger Control Groups. If a match is found, then all associated scene indicators are turned off.

7.3 Document Convention

Numbers are shown in decimal (base ten) with no other special prefixes or indications.

Binary numbers (base 2) are shown with the prefix %.

Hexadecimal numbers (base 16) are shown with the prefix $.

Example: 157 = %10011101 = $9D

7.4 Data Conventions

7.4.1 Trigger Group

The Trigger Group[1] is a byte, used as a filter or selection byte by a device that responds to Trigger Control commands.

If the received Trigger Group byte matches the Trigger Group(s) programmed into the device, the command is considered for further processing.

If the received Trigger Group byte does not match the Trigger Group(s) programmed into the device, the command is ignored.

The following convention is used:

Trigger Group:

Size:	8-bit byte
Range:	$00 .. $FE
Special Cases:	$FF means UNUSED, and will be ignored if present on the bus.

[1] Corresponding to the Lighting Application Group Address.

7.4.2 Action Selector

The Action Selector[2] is a byte, also used as a filter or selection byte by the device to determine its action. This is generally a number used to look up the action in a table, or to activate some kind of action processing strategy.

The number of possible Action Selectors supported is device dependent.

The following convention is used:

Action Selector:

Size:	8-bit byte
Range:	$00 .. $FF
Special Cases:	All Action Selectors in the same Trigger Group are considered to be Mutually Exclusive when used for scenes.

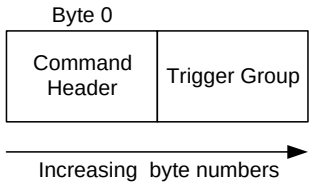
7.4.3 Languages

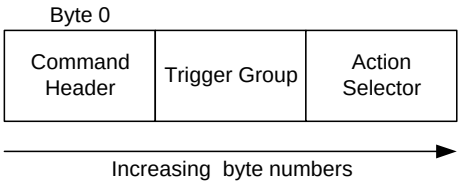
A language is specified when a label is applied, and when the preferred language is set.

The available Languages and their language codes are described in Chapter 2 – Lighting, Switching and Load Control Application.

7.5 Message Structure

Trigger Control Application commands are between 2 and 21 bytes long. The most common commands are 2 or 3 bytes, and have one of the two following forms:





A longer format command is only used for labelling, and is described below.

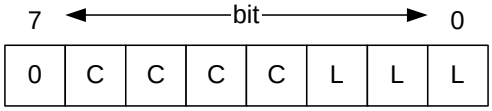
[2] Corresponding to a Lighting Application Level, when used in a RAMP command.

7.5.1 Command Header

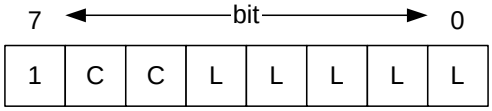
The command header is a byte, broken into bit-fields to support encoding of a command type and the number of bytes following as parameters.

There are two possible codings, to support a large number of commands with short arguments, and a small number of commands with long arguments.

The short argument command form is:



The long argument command form is:



Where “C” represents a bit of a command, and “L” represents a bit of the length.

This command header format provides compatibility with the C-Bus Lighting Application, and is therefore suitable for backward compatibility with older devices and interoperability with lighting units.

7.5.2 Short Form Commands

For the Trigger Control Application, the permitted short form commands are:

TRIGGER EVENT[3]: %0 xxxx 010

The bits “xxxx” can have any value, however 0000 is recommended for all new designs.

> ***There is no guarantee that the use of values other than 0000 will be supported in future. All devices responding to the Trigger Control Application shall accept these bits in any combination and ignore them. New devices shall always transmit these bits as 0000.***

The (3 bit) length field reflects the number of arguments, which is always 2.

TRIGGER MIN[4]: %0 0000 001

The (3 bit) length field reflects the number of arguments, which is always 1.

[3] This command corresponds to a Lighting Application RAMP command.

[4] This command corresponds to a Lighting Application OFF command.

TRIGGER MAX[5]: %0 1111 001

The (3 bit) length field reflects the number of arguments, which is always 1.

INDICATOR KILL[6]: %0 0001 001

The (3 bit) length field reflects the number of arguments, which is always 1.

All other possible encodings of the command header byte for short form commands are reserved, and shall not be issued on the Trigger Control Application.

7.5.3 Long Form Commands

For the Trigger Control Application, the permitted long form commands are:

LABEL[7]: %1 01 xxxxx

The (5 bit) length field reflects the number of arguments.

All other possible encodings of the command header byte for long form commands are reserved, and shall not be issued on the Trigger Control Application.

7.5.4 Label Languages

A language is specified when a label is applied, and when the preferred language is set.

The language codes used for Control Trigger Labels are the same as are used for the Lighting Application. Refer to Chapter 1 for the definition of the Language codes.

7.6 Defined Commands

Control Trigger Application messages are C-Bus Specific Application Language (SAL) messages.

All messages listed are mandatory for C-Bus units that support scenes or use Triggered Events, unless explicitly stated otherwise.

Deviation from these messages will cause C-Bus devices to be incompatible.

Consult Clipsal Integrated Systems before deviating from these messages.

[5] This command corresponds to a Lighting Application ON command.

[6] This command has no equivalent in the Lighting Application.

[7] This command is equivalent to a Lighting Application Label command, although some parameters are treated slightly differently.

7.6.1 Trigger Event

Command: $02

Arguments: <Trigger Group> <Action Selector>

Meaning: Trigger an Event

Originator: Anywhere

Notes: Refer to section 7.2.3 and 7.9 for detailed application behaviour.

For transmission, devices must transmit the command as shown.

For reception, devices must accept commands $02, $12, $22, $32, $42, $52, $62, $72, $0A, $1A, $2A, $3A, $4A, $5A, $6A, $7A as being equivalent.

7.6.2 Trigger Min

Command: $01

Arguments: <Trigger Group>

Meaning: Trigger an Event

Originator: Anywhere

Notes: This is equivalent to $02 <Trigger Group> $00 - in other words the Action Selector is 0.

New devices must not transmit this command.

All devices must accept this command.

7.6.3 Trigger Max

Command: $79

Arguments: <Trigger Group>

Meaning: Trigger an Event

Originator: Anywhere

Notes: This is equivalent to $02 <Trigger Group> $FF - in other words the Action Selector is 255.

New devices must not transmit this command.

All devices must accept this command.

7.6.4 Indicator Kill

Command	$09
Arguments	<Trigger Group>
Meaning	Kill Indicators for Scenes with Trigger Group
Originator	Anywhere
Notes	Any devices that receive this command shall look up the Trigger Group, and if it matches the Trigger Group of an active scene then that scene shall be deactivated and any corresponding indicator shall be switched off.

7.6.5 Label

Command:	%101LLLLL
Arguments:	<Trigger Group> <Options> <Action Selector> <Language> <Text Bytes>
Meaning:	Place a Label against a Trigger Group / Action Selector combination, for all devices on the network that support labelling.
Originator:	Anywhere
Notes:	Labels are only applied to units with label display capabilities. All other units shall receive and discard this message. Refer to section 7.4.1 for the Trigger Group conventions. The “L” bits must be set appropriate to the count of the number of bytes that follow the command. The shortest possible command has 4 bytes following. Loading a label with no text bytes will erase any previously loaded label for the selected language and Group. Multiple label commands are not allowed in the same message. The label command may be concatenated after other trigger commands, however the label command shall be the last command in the message. When setting the Preferred Language, there should not be any text bytes present. <Options> is a set of bit-field codes, with the following meanings for the Trigger Control Application: Bit 0: For Control Trigger, this bit must be 1 Bits 2,1: 00 = Text label 01 = Predefined icon 10 = Load Dynamic icon 11 = Set Preferred Language Bit 3: For Control Trigger, this bit must be 0 Bit 4: Reserved, must be 0 Bit 6, 5: 00 = Flavour 0 01 = Flavour 1

10 = Flavour 2
11 = Flavour 3

Bit 7: Reserved, must be 0. Only set to 1 during certain parts of a Dynamic Icon Load (refer Chapter 2).

<Action Selector> is the action selector number of the a button to be matched for applying a label

<Language> is a Language Code as defined in chapter 2.

<Bytes> is either the label text, an index to a predefined icon, or a stream used to define a dynamic icon, as follows:

For a text label, a stream of up to 16 ASCII coded text bytes;

For Predefined icons, exactly 3 bytes must be present:

$01, Icon_H, Icon_L

Where Icon_H and Icon_L are the high and low order bytes (respectively) of the predefined icon number to display.

For Dynamic icons, up to 16 bytes can be present. The method of loading Dynanmic icons is described in Chapter 2.

7.7 Message Priority

Trigger Control Application messages shall always be transmitted at Class 4 (lowest) priority.

7.8 Internetwork Routing

Trigger Control Application messages may be routed via one or more C-Bus bridges or gateway devices. Such messages will be received with a message type indicating point-multipoint, but will have a non-zero Network routing.

The Network routing information is irrelevant, as responses are not required for Trigger Control Application messages.

7.9 Application Behaviour

7.9.1 Concatenated Commands

A Trigger Control Application device may receive a message containing more bytes than a single command. This permits a single C-Bus transmission to contain multiple commands for a single Application.

Devices using C-Bus Trigger Control Application messages must process all received bytes. This may be achieved by placing the received bytes in a buffer, and using the following simple algorithm, or any other algorithm that is functionally equivalent:

```
WHILE the buffer contains bytes LOOP
    The first byte defines the command header and argument
    count (refer section 7.4.3).
    Process the first (command) byte and its arguments
```

```
        Once processed, remove the command and argument bytes
        from the buffer
    END LOOP
```

7.9.2 Reception of Unknown or Unsupported Commands

Devices receiving a message containing a command header that is not supported shall:

1. Ignore the command, and use the length bits to determine the number of subsequent bytes to skip; and
2. Resume checking for commands after skipping the unknown or unsupported command.

7.9.3 Response Actions

A C-Bus network may include many devices that accept Trigger Control Application messages. These devices shall support at least:

a. Sharing of common Trigger Groups;

   In this case, several devices are programmed to respond on the same Trigger Group number. This permits extension of the number of actions beyond whatever limits are imposed by a single device.[8] When used for scenes, sharing a common Trigger Group can be used to ensure indicators are mutually exclusive.

b. Separate Triggering.

   The Trigger Group numbers to which devices respond are different. The response of the devices is separate and unrelated[9].

A device that receives and responds to a Trigger Control Application message shall generate some series of actions in response. These actions depend on the nature of the device, but may include:

a. issuing one or more C-Bus messages (on any Application); or
b. issuing Infra-Red codes, for the control of consumer devices such as televisions, VCRs, air conditioners, and so on.

7.9.4 Use of Trigger Control for Scenes

When Trigger Control is used for scenes, devices shall implement the following behaviour:

a. All scenes with the same Trigger Group number shall be considered Mutually Exclusive (so only one of those scenes can be active at any time); and

[8] For example, one device could issue C-Bus commands to set lighting levels, and a different device could issue Infra-Red commands to switch on a Television and VCR and rewind the tape.

[9] For example, two Scene Controllers could be used in separate, unrelated parts of a house. Coordinated actions from both may not be useful.

b. All scenes which do not share the same Trigger Group shall be considered Unrelated (so multiple Unrelated scenes on the same unit can be active at any one time).

Further:

c. (Detection of a Broken Scene) When any device detects that its scene is no longer active, by seeing a lighting group member of any active scene change its level, it shall turn off any applicable scene indicators; ***and*** it shall transmit the INDICATOR_KILL message, with the Trigger Group number of the scene being deactivated.

d. (Mutual Exclusion) When any device with an active scene detects a remote trigger of another scene, it shall compare the Trigger Groups of the two scenes. If the trigger groups are the same, the device shall switch off the indicators for the active scene before activating the newly triggered scene.

e. (Propagation of Broken Scene) When any device with an active scene detects an INDICATOR_KILL message, the device shall switch off the indicators for any scene where the received Trigger Group matches the Trigger Group for the active scenes.

7.9.5 Programming of Devices

C-Bus devices that respond to Trigger Control Application messages should have some means of programming the Trigger Group and Action Selector numbers to which they respond, and the various responses they can generate.

This programming may performed using:

a. some kind of C-Bus data load facility;

b. panel programming buttons or keys;

c. participation in C-Bus Lighting Learn mode;

d. listening for C-Bus network traffic as part of a dedicated learn function;

e. a direct connection from a programming device (for example, a PC); or

f. some other technique at the discretion of device manufacturer.

7.9.5.1 Device Behaviour for Label Commands

Devices that cannot be labelled shall accept and discard label commands.

Devices that can be labelled shall always accept label commands. If the supplied group matches a group in the unit, then the label is applied to that group. When labels are applied to a group, all buttons with that associated group are considered for labelling. The label is applied to buttons where the button flavour matches the flavour supplied in the label command. This allows up to 4 different labels to be applied to buttons on the same group.

7.9.5.2 Deleting a Label

A label is deleted by applying label text with length 0. This causes the unit to revert the label for any matching groups to a unit-specific default label.

7.9.5.3 Languages

Units capable of displaying labels always show the label, for each group, in the current preferred language.

If a group does not have a label in the current preferred language, it displays the English (Code 1) label for that group instead.

7.9.5.4 Loading Dynamic Icons as Labels

Loading of Dynamic Icons as Labels is described in detail in Chapter 2 – Lighting, Switching and Load Control Application.

7.10 Status Reporting

Devices using the Trigger Control Application may respond to C-Bus status requests (MMI) issued against the Trigger Control Application Address.

Response to a status MMI is optional, and at the discretion of the device manufacturer. Note that devices using the C-Bus Serial Interface as their means of connection to C-Bus cannot respond to an MMI request.

If a device does respond, it shall only support the Status MMI, and shall report only those Trigger Group Addresses to which it responds. The state reported can be either ON or OFF.

7.11 Limitations

None.

7.12 Examples

These examples assume that a device is causing a Trigger by issuing a message. This device interfaces to C-Bus using the C-Bus Serial Interface, which is described in more detail in CBUS-SIUG.

The examples assume the Serial Interface SRCHK option is set, so that data transfer both to and from the Serial Interface uses a checksum.

To trigger an action in a Scene Master or Touch Screen, which has previously been set up to respond on Trigger Group $25, and Action Selector $01, a device could issue:

To PCI: \05CA0002250109

To perform the same operation on a remote network (through a single bridge with unit address $56 on the side of the sending device, and unit address $37 on the side of the trigger control device), a device could issue:

To PCI: \03**5609**CA022501AC

The internetwork routing bytes ($5609) would be modified by the bridge as the message passed through, to construct the reverse route. The receiving device(s) can ignore this, as the reverse route is not important.

7.13 Notes

Because Trigger Control Application commands have the same format as Lighting Application ON, OFF or instantaneous Ramp to Level commands, standard C-Bus Lighting input devices can be used to trigger actions using the Trigger Control Application.