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Exposure Control in the Canon Wireless Flash System

Douglas A. Kerr, P.E.

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ABSTRACT

The Canon Wireless Flash System allows freestanding Canon Speedlite flash units remote from a Canon EOS-type SLR camera to be controlled and triggered by optical signals transmitted from a master Speedlite flash unit or Speedlite flash control transmitter located at the camera. The system includes flexible provisions for adjusting the relative contribution to exposure of different flash units, including the topic often spoken of as "flash ratio setting". In this article, we describe the system and its exposure control provisions.

INTRODUCTION

Scope

Although this article begins with a general description of the Canon wireless flash system, the major intent of the article is to describe in detail the provisions of the system for control of the contribution of the various flash units to overall exposure. It is not intended to be a complete description of all aspects of the wireless flash system, nor to be a guide to practice in its use.

Caveat

The information upon which this article is based is drawn from such sources as Canon instruction manuals, other Canon documents, information provided by Canon representatives in various on-line forums, information collected and published by other enthusiasts, and observations and tests performed by the author.

The system is complex, and truly-definitive information is hard to come by. A lot of "reading between the lines" is involved, and nothing ever comes out exactly even. The descriptions here represent the author's best interpretation and understanding of the available information.

Readers who have information that seems to point to other realities are encouraged to bring this information to the attention of the author.

The descriptions I give are "tidy" versions of what I discern as the underlying intent of the various behaviors. In reality, the observed relationships may depart somewhat from those ideals (certainly in part owing to measurement error).

THE CANON WIRELESS FLASH SYSTEM

Functionality

The Canon Wireless Flash System allows freestanding Speedlite flash units remote from the camera to be triggered by optical signals transmitted from a Speedlite master flash unit or a Speedlite flash control transmitter located at a Canon EOS-type SLR camera (film or digital). The system allows full exercise of the sophisticated flash exposure metering arrangements provided in the various Canon cameras supporting the system.

Compatible cameras

The Canon wireless flash system can be utilized with all Canon EOS-type SLR cameras. With certain of the earlier EOS film cameras (known for this purpose as "Type B" cameras), there are some limitations of system features. With the newer EOS cameras, including all the EOS digital cameras (known for this purpose as "Type A" cameras), full functionality is supported. The descriptions in this article pertain to operation with a Type A camera (including any digital EOS camera).

Slave units

The remote ("slave") units for wireless operation may be any Canon Speedlite EX-series flash unit (*i.e.*, one whose model number ends in "EX"). In general, the special features available on a particular model under wireless operation are the same as are available when that model is used in the basic way, on the camera. (2nd-curtain sync operation is, however never possible under wireless operation.)

The master unit

The master unit, which sends the wireless control signals to the slave units, and from whose control panel the entire wireless "network" is managed by the user, may be a Canon Speedlite 550EX or 580EX unit. In such a case, the master unit may (and by default does) actually act as a flash unit (rather like a bandleader who also plays an instrument). However, one may set the master to not actually emit a flash for exposure, if it is desired to have it be only a "transmitter" for a particular shot.

The master unit may also be a Canon Speedlite Transmitter ST-E2. It does not have "flash unit" capability. The ST-E2 has somewhat more limited control capabilities than a 550EX or 580EX used as a master unit.

The master unit or transmitter must either be in the camera's flash shoe or be connected to it by an off-camera shoe cord.

In this article, we will only discuss the operation of the unit with a 550EX or 580EX flash unit as the master unit. Much of the information is applicable to the use of the ST-E2, subject to the limitations I have hinted at above.

Slave ID codes and control groups

Each slave unit may be set to have one of three *slave ID codes*, A, B, or C. In this way, the slave units are essentially placed in up to three "control groups" for exposure control purposes, and we will speak of operation in terms of such groups. The master unit (if a 550EX or 580EX), in its role as a flash unit proper, always operates as if in group A.

More than one unit may be placed in any group. There is no explicit limit on the overall number of units that may be deployed. Multiple units in a single group cannot be separately controlled with regard to output level or otherwise.

Metered and manual operation

Flash units operating under the wireless system are normally fully controlled under the E-TTL or E-TTL II flash metering system, whichever is practiced by the camera model in use.

When the particular flash unit model supports "manual" exposure control ("settable fixed output"), that mode may be utilized in a wireless network setup. When the master is a 550EX or 580EX, the output level for each group may be controlled from the master. We will not discuss this mode further in this article.

Wireless control signals

The slave units are controlled by coded light signals emitted by the master flash unit or transmitter. In the case of a master flash unit, these signals are white light, emitted by the unit's normal flash tube (at a fairly low intensity). In the case of the flash transmitter, the light signals are a long-wavelength red light (often miscalled "near infrared light"; "nearly infrared" would be more apt). These red light signals have low visibility to observers.

Except for the last command of the protocol ("fire now"), these signals are emitted before the camera shutter opens, and thus have absolutely no effect on exposure. The light from the last command can make a very tiny contribution to exposure, ordinarily completely negligible.

EXPOSURE CONTROL

General concept

By assigning the flash units to different groups, they may be independently controlled insofar as their output level is concerned. This makes it possible for the user to tailor the relative contributions to exposure of the various units in order to produce the desired lighting effect.

In this regard, the system design assumes that the unit(s) assigned to groups A and B will be used to illuminate the "main subject" (typically from different angles), but

that the unit(s) assigned to group C will be used to illuminate a separate "auxiliary surface" (typically a background). Of course, this deployment concept need not necessarily be followed, but if the unit(s) in group C are used as a third source of illumination on the main subject, special steps may need to be taken to assure proper exposure. (This will be discussed later.)

The significance of the "flash ratio"

The ability to tailor the relative exposure contributions of the group A and B units is done through the "flash ratio" capability of the system. There are three basic ratio modes, selectable on the control panel of the master flash unit. We will discuss operation under each of these.

Flash Ratio OFF

With Flash Ratio OFF, all slave units, regardless of the group to which they are assigned, A, B, or C (including the master unit itself, assuming that its role as a flash unit proper has not been disabled), will be fired at the same output level. (The precise significance of "output level" will be discussed later in this article.) This output level will be chosen by the metering system so that the collective illumination from all the units will produce the desired overall illumination of the subject for proper exposure.

In this situation, the relative exposure contributions of the various units will depend on their respective distances from the subject, the angles at which their illumination strikes the surface of the subject, and the beamwidth (head zoom) setting of the unit. (Some models as slaves always operate with the widest basic beamwidth.) The user has no opportunity in this mode to tailor the relative exposure contribution of the different units.

Flash Ratio ON A:B

In this mode, the units in groups A and B are separately controlled as to their output level. Any units assigned to group C do not fire at all in this mode.

If the A:B ratio is set to 1:1, the metering system sets the output levels of the A and B group units so that the illumination afforded by the two groups is equal (regardless of their distances from the subject or the other factors mentioned earlier). The system is able to do this by having each group fire a separate metering preflash, whose "return" from the main subject is separately analyzed to determine the "leverage" that group has on the illumination of the main subject.

It is important to note that setting the output levels to produce equal contributions to exposure (as we have in this case) is quite different from setting equal output levels (as we had with Flash Ratio OFF).

If the user wishes one group of units to make a greater contribution to exposure than the other, then the A:B ratio may be set to another value. For example, if the A:B ratio is set to 4:1, then the contribution to exposure of the A group unit(s) will be four times that of the B group unit(s). This gives the user a valuable ability to tailor the resulting lighting effect. The A:B ratio may be set to values from 8:1 (*e.g.*, 8:1 in favor of A) to 1:8 (*e.g.*, 8:1 in favor of B).

If there is more than one unit in a group, all will be fired with the same output level. As before, the relative contribution to exposure among the units in one group will depend on their respective distances from the subject and the other factors mentioned above. However, the relative contribution to exposure of each entire group will be controlled by the A:B ratio setting just as when there is only one unit in a group.

Flash Ratio ON A:B C

In this mode, the unit(s) assigned to group C will fire. The units in groups A and B are operated as in the previous case, their output levels being set by the metering system so that (with no allowance for any contribution of group C) they will collectively provide proper exposure for the main subject.[1] The relative contributions of the two groups to the exposure of the main subject can be controlled by setting the A:B ratio, as before.

The unit(s) in group C have their output levels set by the metering system so that they (with no allowance for the contribution of groups A and B) will collectively provide proper exposure for the auxiliary surface (the "background").[2]

A corollary of this assumed separation of the "targets" for groups A and B and group C emerges if we in fact aim the group C unit(s) at the main subject. Both the "A+B team" and the C group will try to provide 100% of the required illumination. Thus there will be a "piling on" of illumination that typically results in overall illumination greater than that required for proper exposure. In the case where all the flash units illuminate the same surface of the subject, the result can be a doubling of the required illumination (a "one-stop" overexposure).

Compensation for this phenomenon, if actually required, can be readily done though the use of the flash exposure control (FEC) facility of the system, to be described shortly.

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[1] Note that the presumed scenario is one in which the C group unit does not illuminate the main subject in any significant way.

[2] Note that the presumed scenario is one in which the A and B group units do not illuminate the background in any significant way.

A misconception about the mode Flash Ratio ON A:B C

There is a widespread misconception that in this mode, the system seeks to attain proper exposure of "the subject" through the collective illumination provided by groups A, B, and C, in such a way that (by default) the contributions of the three groups are equal. Thus, there would be a concept of a "ratio" of the contributions of groups A, B, and C. But as we have just seen, this is not the way the system operates.

The ratio of the exposure impact of groups A:B is a meaningful concept, since they are assumed to collaborate on the illumination of the same subject. But the ratio of the contribution of C to the joint contribution of A and B is not meaningful, since they are not assumed to be collaborating on the exposure of the same subject.

In fact, the designation of the mode we are discussing as "Ratio A:B C", rather than "Ratio A:B:C", is a reminder of the actual facts of the matter. "Ratio A:B C" is short for "A and B active, with a controllable ratio between them, and C active". (In some places, the 550EX manual calls that setting "Ratio A:B:C", but that is just editorial carelessness.) There is no "Ratio A:B:C setting.)

Flash Exposure Control (FEC)

Flash exposure control (FEC) allows the user, in a normal single flash setup, to vary the illumination afforded by the flash unit above or below that chosen by the flash metering system.

This capability also applies in a wireless flash network. The "basic" flash exposure control setting on the master flash unit[3] affects the illumination afforded by all units in the network (regardless of their group assignment, A, B, or C), causing that illumination to be greater or less than what would ordinarily be called for by the flash metering system. The "balance" among the relative contributions to exposure of the various groups is nominally unchanged by such a setting. (This is not quite true in reality.)

In addition, when Flash Ratio is set to A:B C, enabling units in group C, there is available a separate "group C" flash exposure compensation setting (on the master flash unit). This varies the exposure afforded by group C only. This is in addition to the effect on group C of any "basic" FEC setting.

Some people like to describe this as "adjustment of the ratio between C and A + B". Of course, if we change the output of C, it will indeed change the ratio of that output to the output of A + B (or to the output of my table lamp).

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[3] The basic FEC can also be set on the camera, for most camera models. Any non-zero setting on the flash unit, however, overrides any setting on the camera.

But as we discussed above, this outlook is not really meaningful, since the system does not initially strive to attain any ratio of the contribution of group C to that of "team A + B". Rather, it strives to make each independently appropriate for the exposure of the part of the scene which is it's "client". If we change the impact of C, that's the objective—not changing it as compared to A + B.

The "A+C" situation

A common use for the wireless flash system is to have a single flash unit (typically the master, on-camera) for illumination of the main subject and a second unit for illumination of the background. To allow independent metering for the second unit (as befits that division of labor), we should assign it to group C. There is, however, no system mode for "A group enabled, C group enabled". Thus we must set the system mode to Flash Ratio A:B C to make C fire.

In such a case, if the A:B ratio is set to 1:1, the metering system sets the output level for group A so that this group will provide half the needed illumination of the main subject, and tries to set the output level for group B so it will also provide half the needed illumination. But there are no group B units, and so their contribution never arrives. Thus, the illumination afforded the main subject (by group A alone) is about half what is needed for proper exposure (a "one-stop" shortfall).[4]

To avert this, we can set the A:B ratio to 8:1. In that case, the "quota" for group A becomes 8/9 the total required illumination. Thus the output level for group A will cause group A to very nearly provide the entire needed illumination of the main subject (only about "1/6 stop" short, in theory).

Group C, as we might expect, just goes about its business in the regular way.

About "output level"

Throughout this article, I have blithely spoken of the "output level" of a flash unit without saying just what that means.

I actually use that term to refer to the total luminous energy output of a flash unit's burst (the luminous flux-time product, to be precise).

This is in fact not the property that describes the illumination afforded by the flash burst on the subject surface (which is an illuminance-time product). That is determined by the luminous energy output, the width of the flash beam, the

[4] You might think that the system would realize what is happening here when it sees no return from the group B metering preflash and would then look to group A to do the whole job for the main subject, but not so.

distance from the unit to the subject, and the angle at which the beam strikes the subject surface.

The flash metering system makes its decision regarding the needed output level by observing the ”return” from the scene from a metering preflash burst, which is emitted by the flash unit with a standard output level (that is, a standard luminous energy). Thus the relative level of the return (a luminance-time product) reflects, in addition to the preflash output level, the effect of the current beamwidth setting of the flash unit, the distance to the subject, the angle of incidence, and the reflectance of the subject.

Accordingly, the metering system can provide for the proper exposure contribution by setting an output level, since that output level will “work through” the same chain of affecting factors (beamwidth, distance, etc.) as did the metering preflash (whose output level is known).

I assume that the output level is described to the flash unit over the command link in absolute terms, not in terms of a fraction of the maximum output of the particular flash unit model (such as we use when setting the output level in the “manual” mode). This would seem necessary for the wireless flash system to be able to provide for proper balance among the exposure impacts of multiple flash units with possibly-different maximum output levels. Tests here seem to confirm this, but I don’t have enough flash units or test equipment to be absolutely certain.

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