S18 Series Sensors (DC Voltage)

Datasheet

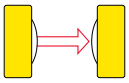
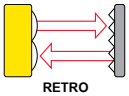
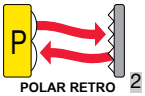
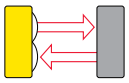
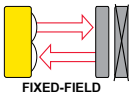


- Featuring EZ-BEAM® technology for reliable sensing without the need for adjustments
- Completely epoxy-encapsulated to provide superior durability, designed to meet rigorous IP69K standards for use in 1200 psi washdowns
- Innovative dual-indicator system for simple sensor performance monitoring
- Advanced diagnostics to warn of marginal sensing conditions or output overload
- 10 to 30 V dc; choose SPDT (complementary) NPN or PNP outputs (150 mA maximum, each)

WARNING:

- **Do not use this device for personnel protection**
- Using this device for personnel protection could result in serious injury or death.
- This device does not include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A device failure or malfunction can cause either an energized (on) or de-energized (off) output condition.

Models

Sensing Mode	Model [1]		Range	LED	Output
 OPPOSED	**S186E**	Emitter	20 m (66 ft)	Infrared 950 nm	-
	S18SN6R	Receiver			NPN
	S18SP6R				PNP
 RETRO	**S18SN6L**		2 m (79 in)	Infrared 950 nm	NPN
	S18SP6L				PNP
 POLAR RETRO [2]	**S18SN6LP**		2 m (79 in)	Visible Red 680 nm	NPN
	S18SP6LP				PNP
 DIFFUSE	**S18SN6D**		100 mm (4 in)	Infrared 880 nm	NPN
	S18SP6D				PNP
	S18SN6DL		300 mm (12 in)		NPN
	S18SP6DL				PNP
 FIXED-FIELD	**S18SN6FF25**		25 mm (1 in) cutoff	Infrared 880 nm	NPN
	S18SP6FF25				PNP
	S18SN6FF50		50 mm (2 in) cutoff		NPN
	S18SP6FF50				PNP
	S18SN6FF100		100 mm (4 in) cutoff		NPN
	S18SP6FF100				PNP

Note: Users must purchase one emitter and one receiver for opposed mode sensors.

1 Standard 2 m (6.5 ft) cable models are listed.
- To order the 9 m (30 ft) cable models, add suffix **W/30** (for example, **S186E W/30**).
- To order the 4-pin M12/Euro-style QD models, add suffix **Q** (for example, **S186EQ**). A model with a QD connector requires a mating cable.

2 Use polarized models when shiny objects will be sensed.

Fixed-Field Mode Overview

S18 self-contained fixed-field sensors are small, powerful, infrared diffuse mode sensors with far-limit cutoff (a type of background suppression). Their high excess gain and fixed-field technology allow them to detect objects of low reflectivity, while ignoring background surfaces.

The cutoff distance is fixed. Backgrounds and background objects must always be placed beyond the cutoff distance.

The S18FF compares the reflections of its emitted light beam (E) from an object back to the sensor's two differently aimed detectors, R1 and R2. If the near detector (R1) light signal is stronger than the far detector (R2) light signal (see object A, closer than the cutoff distance), the sensor responds to the object. If the far detector (R2) light signal is stronger than the near detector (R1) light signal (see object B, beyond the cutoff distance), the sensor ignores the object.

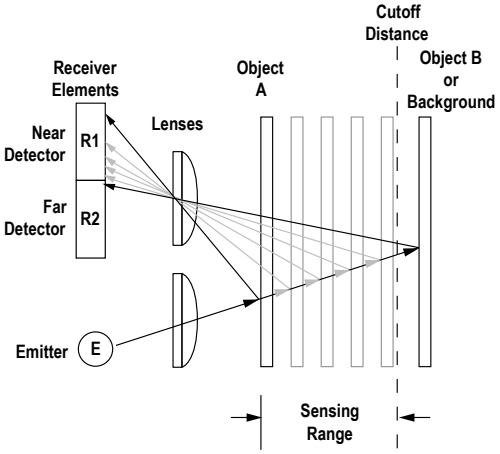


Figure 1. Fixed-field concept

The cutoff distance for model S18FF sensors is fixed at 25, 50 or 100 millimeters (1 in, 2 in, or 4 in). Objects lying beyond the cutoff distance usually are ignored, even if they are highly reflective. However, it is possible to falsely detect a background object, under certain conditions (see Background Reflectivity and Placement).

In the drawings and discussion on these pages, the letters E, R1, and R2 identify how the sensor's three optical elements (Emitter "E", Near Detector "R1", and Far Detector "R2") line up across the face of the sensor. The location of these elements defines the sensing axis (see *Figure 2* (p. 2)). The sensing axis becomes important in certain situations, such as those illustrated in *Figure 5* (p. 3) and *Figure 6* (p. 3).

Sensor Setup

Sensing Reliability

As a general rule, the most reliable sensing of an object approaching from the side occurs when the line of approach is parallel to the sensing axis.

For highest sensitivity, position the target object for sensing at or near the point of maximum excess gain. The excess gain curves for these products are shown. Maximum excess gain for the 25 mm models occurs at a lens-to-object distance of about 7 mm; for 50 mm models, at about 10 mm; and for the 100 mm models, at about 20 mm. Sensing at or near this distance will make maximum use of each sensor's available sensing power. The background must be placed beyond the cutoff distance. (Note that the reflectivity of the background surface also may affect the cutoff distance.) Following these two guidelines will improve sensing reliability.

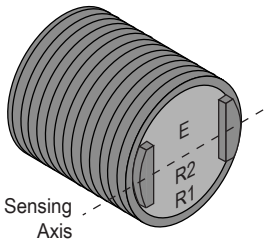


Figure 2. Fixed-field sensing axis

Background Reflectivity and Placement

Avoid mirror-like backgrounds that produce specular reflections. False sensor response will occur if a background surface reflects the sensor's light more strongly to the near detector, or "sensing" detector (R1), than to the far detector, or "cutoff" detector (R2). The result is a false ON condition (see *Figure 3* (p. 3)). To cure this problem, use a diffusely reflective (matte) background, or angle either the sensor or the background (in any plane) so the background does not reflect light back to the sensor (see *Figure 4* (p. 3)). Position the background as far beyond the cutoff distance as possible.

An object beyond the cutoff distance, either stationary (and when positioned as shown in *Figure 5* (p. 3)), or moving past the face of the sensor in a direction perpendicular to the sensing axis, can cause unwanted triggering of the sensor if more light is reflected to the near detector than to the far detector. The problem is easily remedied by rotating the sensor 90° (*Figure 6* (p. 3)). The object then reflects the R1 and R2 fields equally, resulting in no false triggering. A better solution, if possible, may be to reposition the object or the sensor.

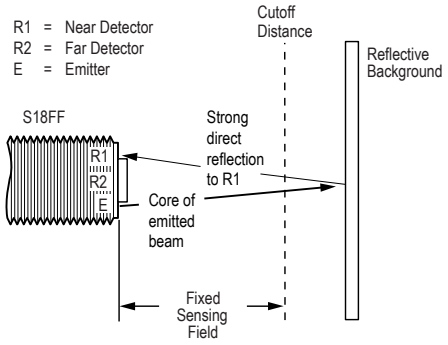


Figure 3. Reflective Background - Problem

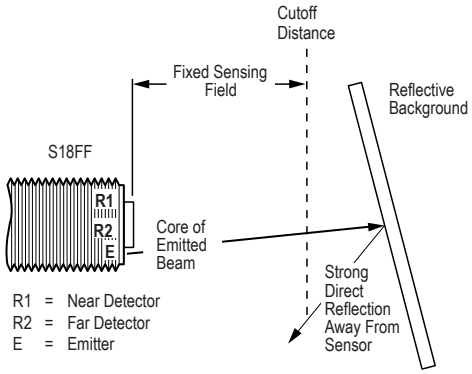


Figure 4. Reflective Background - Solution

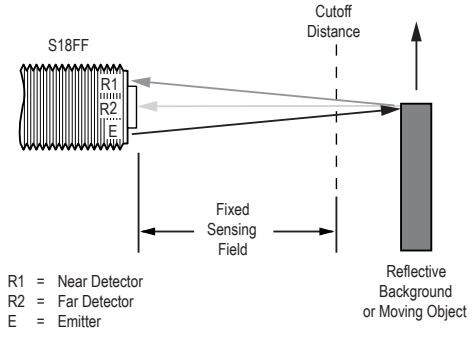


Figure 5. Object Beyond Cutoff - Problem

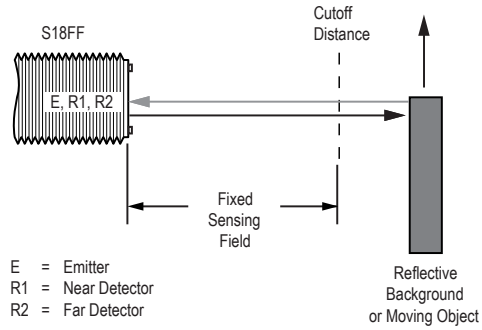


Figure 6. Object Beyond Cutoff - Solution

A reflective background object in this position or moving across the sensor face in this axis and direction may cause false sensor response.

A reflective background object in this position or moving across the sensor face in this axis will be ignored.

Color Sensitivity

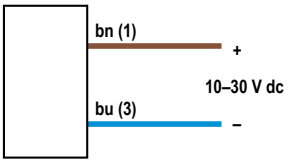
The effects of object reflectivity on cutoff distance, though small, may be important for some applications. It is expected that at any given cutoff setting, the actual cutoff distance for lower reflectance targets will be slightly shorter than for higher reflectance targets (see *Performance Curves*). This behavior is known as color sensitivity.

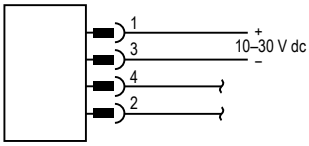
For example, an excess gain of 1 for an object that reflects 1/10 as much light as the 90% white card is represented by the horizontal graph line at excess gain = 10. An object of this reflectivity results in a far limit cutoff of approximately 20 mm (0.8 inches), for the 25 mm (1 inch) cutoff model for example; thus 20 mm represents the cutoff for this sensor and target.

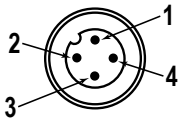
These excess gain curves were generated using a white test card of 90% reflectance. Objects with reflectivity of less than 90% reflect less light back to the sensor, and thus require proportionately more excess gain in order to be sensed with the same reliability as more reflective objects. When sensing an object of very low reflectivity, it may be especially important to sense it at or near the distance of maximum excess gain.

Wiring Diagrams

Cabled Emitters	QD Emitters	Pinout (male)	Key

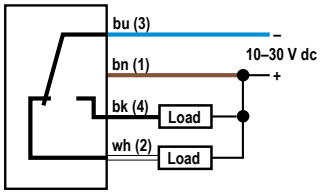


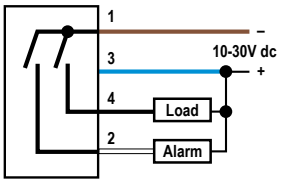


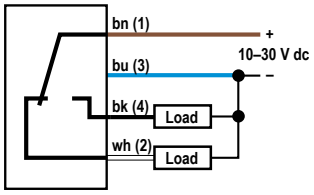


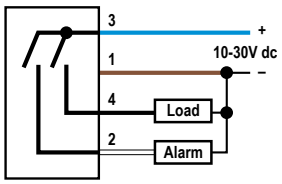
1. Brown
2. White
3. Blue
4. Black

NPN Standard	NPN Alarm	PNP Standard	PNP Alarm









Wiring for the quick disconnect (QD) models is functionally identical.

Specifications

Supply Voltage and Current
10 to 30 V dc (10% maximum ripple)
Supply current (exclusive of load current):
Emitters, non-polarized retroreflective, retroreflective, diffuse models: 25 mA
Receivers: 20 mA
Polarized retroreflective models: 30 mA
Fixed-field models: 35 mA

Supply Protection Circuitry
Protected against reverse polarity and transient voltages

Indicators
Two LEDs (green and amber):
Green on: power to sensor is on
Green flashing: output is overloaded
Amber on: N.O. output is conducting
Amber flashing: excess gain marginal (1 to 1.5×) in light condition

Construction
Housing: PBT polyester housing
Lens: polycarbonate (opposed-mode) or acrylic (other models)

Connections
2 m (6.5 ft) integral cable; 9 m (30 ft) integral cable; or 4-pin M12/Euro-style quick-disconnect fitting

Operating Conditions
–40 °C to +70 °C (–40 °F to +158 °F)
90% at +50 °C maximum relative humidity (non-condensing)

Environmental Rating
Leakproof design rated NEMA 6P and IEC IP67 per IEC 60529
IP69K per DIN40050 for quick disconnect and cable models when the cables are protected from direct spray

Vibration and Mechanical Shock
All models meet MIL-STD-202F, Method 201A (Vibration: 10 Hz to 60 Hz maximum, 0.06 inch (1.52 mm) double amplitude, 10G acceleration) requirements.
Method 213B conditions H&I.
Shock: 75G with device operating; 100G for non-operation

Certifications

Output Configuration
SPDT solid-state dc switch; Choose NPN (current sinking) or PNP (current sourcing) models
Light Operate: N.O. output conducts when sensor sees its own (or the emitter's) modulated light
Dark Operate: N.C. output conducts when the sensor sees dark; the N.C. (normally closed) output may be wired as a normally open marginal signal alarm output, depending upon wiring to power supply (U.S. patent 5087838)

Output Rating
150 mA maximum (each) in standard wiring. When wired for alarm output, the total load may not exceed 150 mA.
OFF-state leakage current: < 1 microamp at 30 V dc
ON-state saturation voltage: < 1 V at 10 mA dc; < 1.5 V at 150 mA dc

Output Protection Circuitry
Protected against false pulse on power-up and continuous overload or short circuit of outputs

Output Response Time
Opposed mode models: 3 ms ON, 1.5 ms OFF
Retroreflective, fixed-field, and diffuse mode models: 3 ms ON and OFF
NOTE: 100 ms delay on power-up; outputs do not conduct during this time.

Repeatability
Opposed mode models: 375 µs
Retroreflective, fixed-field, and diffuse mode models: 750 µs
Repeatability and response are independent of signal strength.

Required Overcurrent Protection

WARNING: Electrical connections must be made by qualified personnel in accordance with local and national electrical codes and regulations.

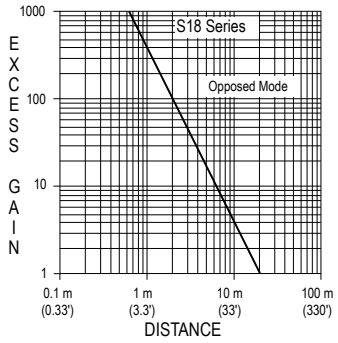
Overcurrent protection is required to be provided by end product application per the supplied table.
Overcurrent protection may be provided with external fusing or via Current Limiting, Class 2 Power Supply.
Supply wiring leads < 24 AWG shall not be spliced.
For additional product support, go to *www.bannerengineering.com*.

Supply Wiring (AWG)	Required Overcurrent Protection (Amps)
20	5.0
22	3.0
24	2.0
26	1.0
28	0.8
30	0.5

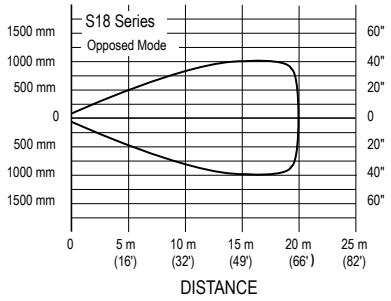
Performance Curves

Opposed Mode

Excess Gain

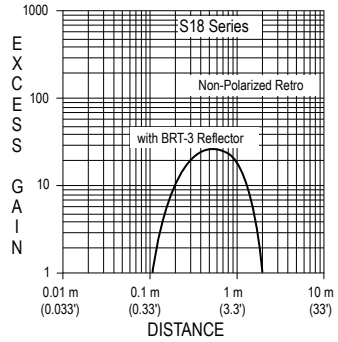


Beam Pattern

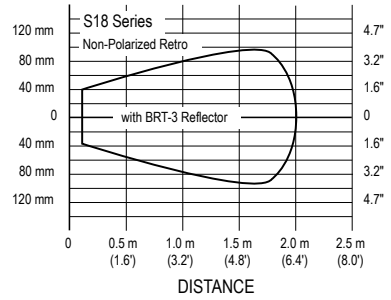


Retroreflective Mode [3]

Excess Gain

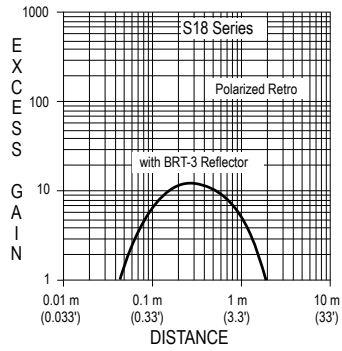


Beam Pattern

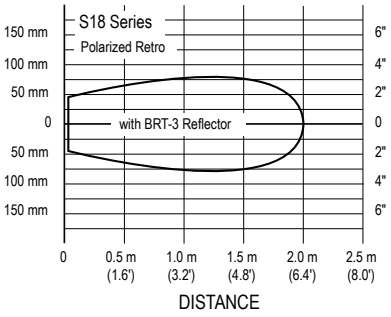


Polarized Retroreflective Mode [3]

Excess Gain



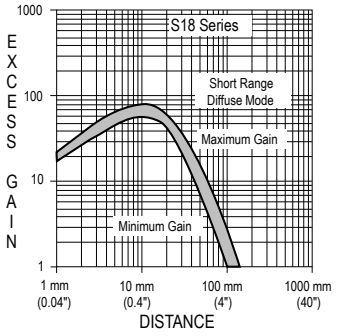
Beam Pattern



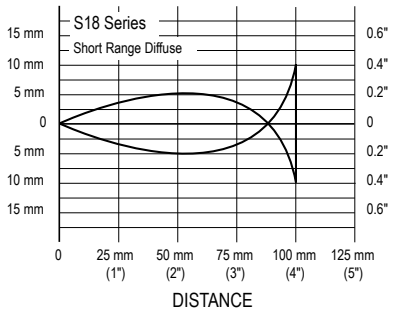
[3] Performance based on use of a model BRT-3 retroreflector (3" diameter). Actual sensing range may be more or less than specified, depending on the efficiency and reflective area of the retroreflector used.

Diffuse 100 mm Mode [4]

Excess Gain

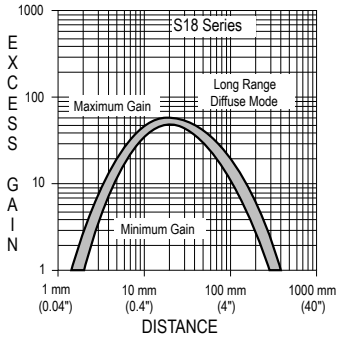


Beam Pattern

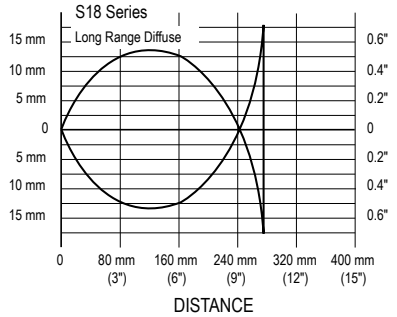


Diffuse 300 mm Mode[4]

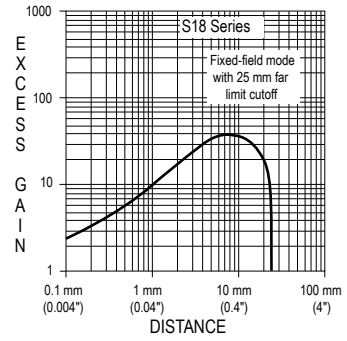
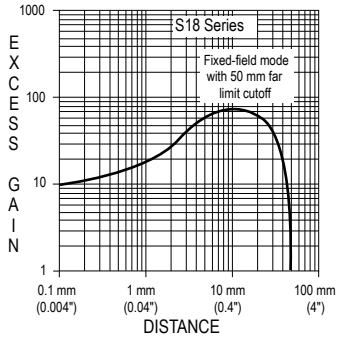
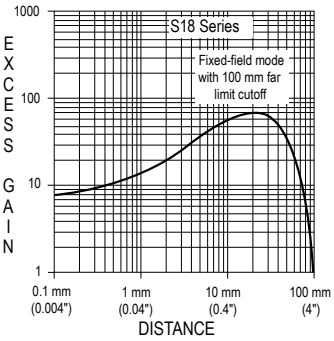
Excess Gain



Beam Pattern



Fixed-Field [4]

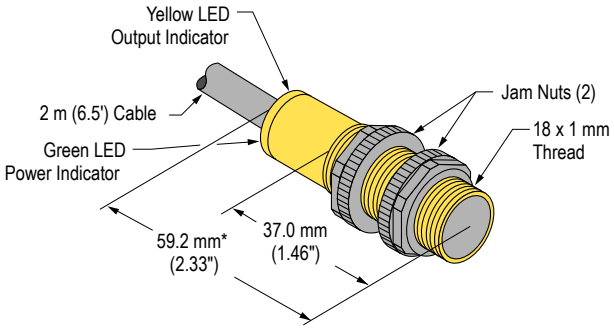
25 mm Mode	50 mm Mode	100 mm Mode
Excess Gain	**Excess Gain**	**Excess Gain**
		
Using 18% gray test card: Cutoff distance will be 95% of value shown. Using 6% black test card: Cutoff distance will be 90% of value shown.	Using 18% gray test card: Cutoff distance will be 90% of value shown. Using 6% black test card: Cutoff distance will be 85% of value shown.	Using 18% gray test card: Cutoff distance will be 85% of value shown. Using 6% black test card: Cutoff distance will be 75% of value shown.
Ø 10 mm spot size @ 8 mm focus	Ø 10 mm spot size @ 10 mm focus	Ø 10 mm spot size @ 20 mm focus
Ø 10 mm spot size @ 25 mm cutoff	Ø 10 mm spot size @ 50 mm cutoff	Ø 10 mm spot size @ 100 mm cutoff

Focus and spot sizes are typical.

[4] Performance based on use of a 90% reflectance white test card.

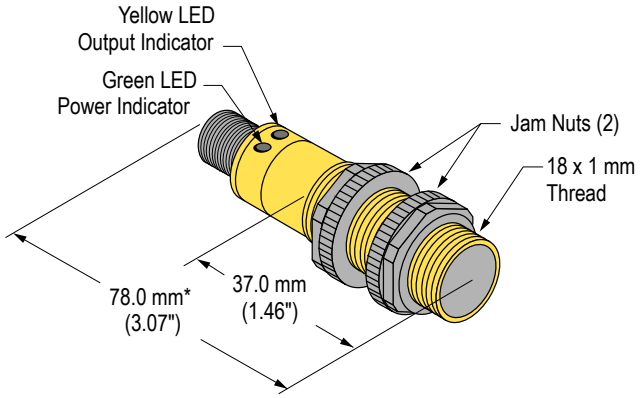
Dimensions

Cabled Models



*Polarized retro and fixed-field models = 65.0 mm (2.56")

QD Models

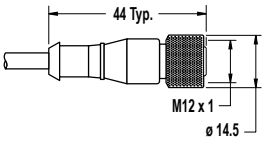
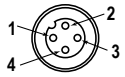
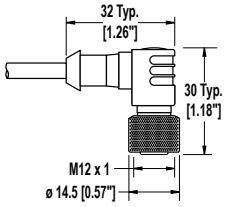


*Polarized retro and fixed-field models = 83.8 mm (3.30")

Accessories

Cordsets

4-Pin Threaded M12/Euro-Style Cordsets—Single Ended

Model	Length	Style	Dimensions	Pinout (Female)
MQDC-406	1.83 m (6 ft)	Straight		 1 = Brown 2 = White 3 = Blue 4 = Black
MQDC-415	4.57 m (15 ft)			
MQDC-430	9.14 m (30 ft)			
MQDC-450	15.2 m (50 ft)			
MQDC-406RA	1.83 m (6 ft)	Right-Angle		
MQDC-415RA	4.57 m (15 ft)			
MQDC-430RA	9.14 m (30 ft)			
MQDC-450RA	15.2 m (50 ft)			

Banner Engineering Corp. Limited Warranty

Banner Engineering Corp. warrants its products to be free from defects in material and workmanship for one year following the date of shipment. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture which, at the time it is returned to the factory, is found to have been defective during the warranty period. This warranty does not cover damage or liability for misuse, abuse, or the improper application or installation of the Banner product.

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FCC Part 15 and CAN ICES-3 (B)/NMB-3(B)

This device complies with part 15 of the FCC Rules and CAN ICES-3 (B)/NMB-3(B). Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules and CAN ICES-3 (B)/NMB-3(B). These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the manufacturer.

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