AN-2196 LM3435 Evaluation Board

1 Introduction

The Texas Instruments LM3435 Evaluation Board has been designed for evaluating the performance of the device in a typical pico projector application. The end user can interface his own system to the evaluation board to test out the performance of the system. With LM3435, the system requires only single DC-DC converter to drive three color LEDs instead of using three DC-DC converters with conventional design. The suggested approach not only saves components cost, but also releases invaluable PCB space to the system and enhances system reliability. Assuming the handy projector is powered by a single lithium battery cell or a 5Vdc wall mount adaptor, the key specifications of the evaluation board are:

Supply voltage range, V_{IN} = 2.7V to 5.5V

Preset LED current per channel, I_{LED} = 1.5A

Minimum LED current per channel, $I_{LED(MIN)}$ = 600mA

Maximum LED forward voltage drop, V_{LED} = 3.5V @ 1.5A

Flyback converter switching frequency, F_{SW} = ~500kHz

2 Evaluation Board Schematic Diagram

The complete schematic diagram of the evaluation board is shown in Figure 1. For the details of the design, please see *LM3435 Compact Sequential Mode RGB LED Driver with I2C Control Interface* (SNVS724).

3 Connecting the Evaluation Board to the System

The LM3435 Evaluation Board is optimized to run with input voltages ranging from 2.7V to 5.5V and requires a supply current not less than 4.1A for full range operation. A connection diagram to show the configuration between the system and the evaluation board is shown in Figure 2. Proper connections to the I/Os must be confirmed before powering up the board. In order to avoid false triggering of the OPEN/SHORT fault detect of the device, the control pins GCTRL, BCTRL, and RCTRL must be kept in logic “LOW” during power-up.

4 Interfacing with the I²C Bus

The current setting resistors only determine the nominal maximum LED current and the actual LED current can be further adjusted on-the-fly by the internal ten bits register for individual channel. The content of these registers are user programmable via standard I²C bus. The connection between the system MCU and the I²C bus is illustrated in Figure 2. The resolution is 1 out of 1024 part of the LED current setting. The user can program the registers in the range from full output, that is, 1023 (3FFH) to minimum LED current that is restricted by the inductor ripple current amplitude. For Projected On-Time (POT) scheme used in LM3435, a minimum inductor ripple current of 300mA_{PK-PK} is required to maintain proper operation. For the details of the registers addresses and definitions, please see *LM3435 Compact Sequential Mode RGB LED Driver with I2C Control Interface* (SNVS724).

5 Interfacing with the GPIO Bus

The PWM control pins GCTRL, BCTRL, and RCTRL are internally pulled low, push-pull I/O ports are recommended to interface properly with the system MCU. The device enable, EN pin is internally pulled high, so an open drain I/O port is recommended.

6 Changing the Preset LED Current

The factory preset LED current of the LM3435 evaluation board is 1.5A, In case the user need to make a change of the preset LED current, it can be done by simply replacing the LED current setting resistors R1, R2 and R3. The $I_{LED(MIN)}$ condition should not be violated for proper regulation, that is, the I_{LED} current for all operation conditions must be no less than 600mA with this evaluation board. Some popular values for user's reference are listed in below. For details about the operation and calculations of the components, please see *LM3435 Compact Sequential Mode RGB LED Driver with I2C Control Interface* (SNVS724).

Preset LED Current, I_{LED}	R1, R2, R3 Value
1.5A	16.5kΩ
1.0A	24.75kΩ
0.75A	33.0kΩ

7 Evaluation Board Schematic

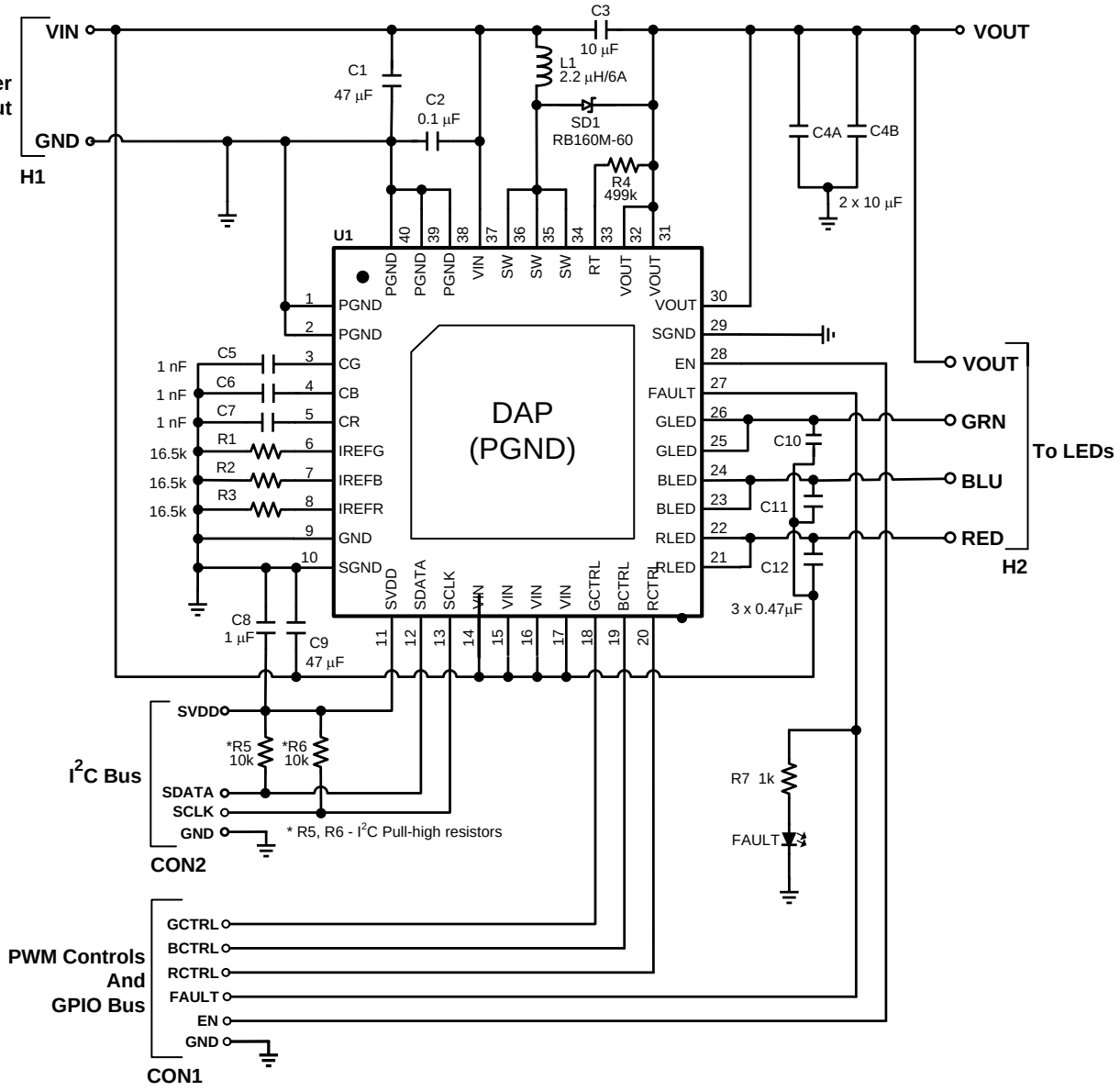

Figure 1. Evaluation Board Schematic Diagram

8 Connection Diagrams

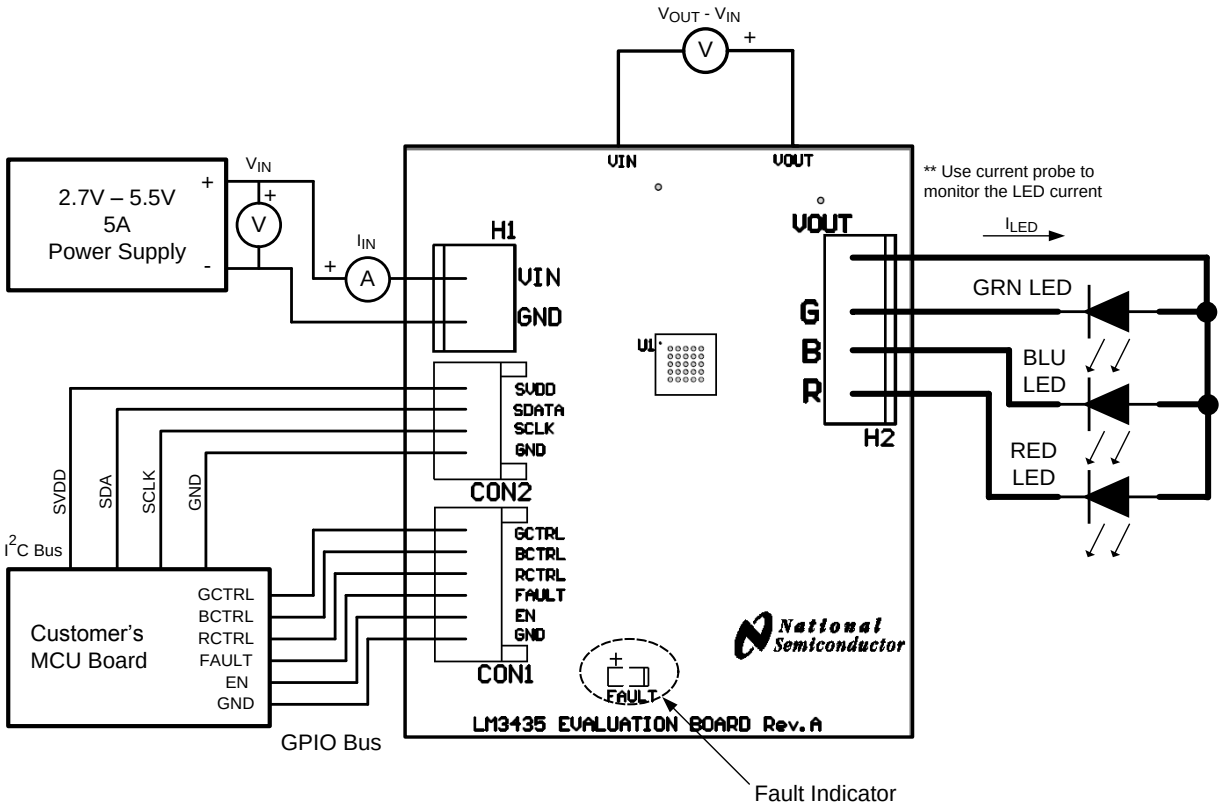

Figure 2. Evaluation Setup Connection Diagram

9 Typical Performance Waveforms

All curves taken at VIN = 5V with configuration in typical application for driving one red (OSRAM LRW5AP-KZMX), one green (OSRAM LTW5AP-LZMY) and one blue (OSRAM LBW5AP-JYKX) LEDs with I_{LED} per channel = 1.5A under T_A = 25°C, unless otherwise specified.

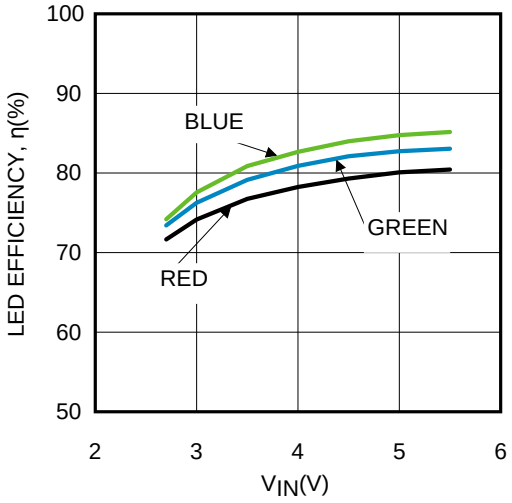

Figure 3. LED Efficiency vs V_{IN}@ TA=25°C

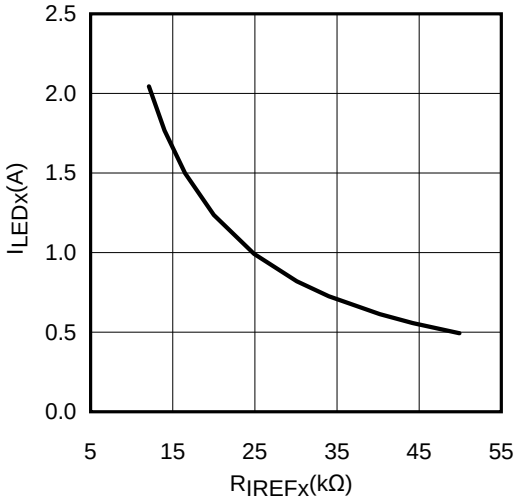

Figure 4. I_{LEDx} vs R_{IREFx}

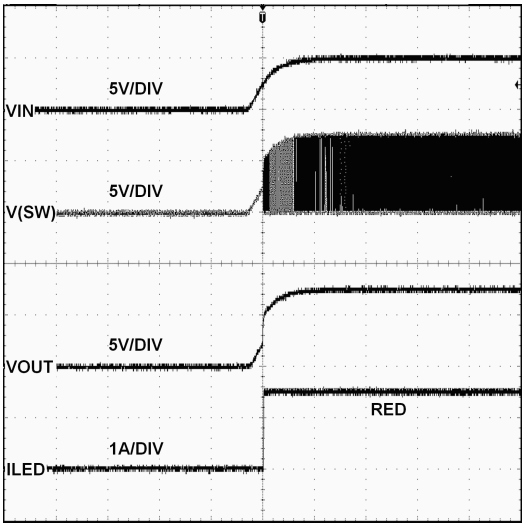

Figure 5. Power Up Transient (10ms/DIV)

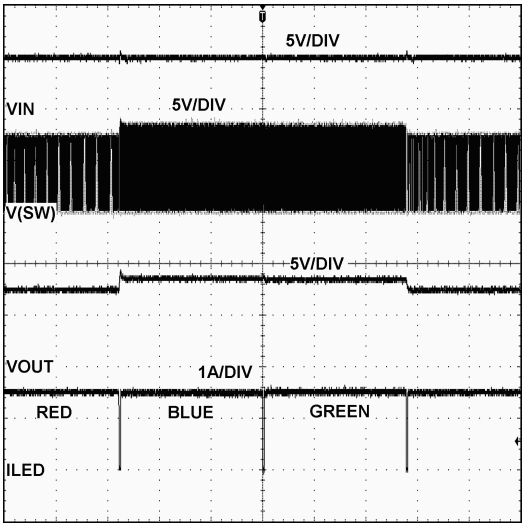

Figure 6. RGB Sequential Mode Operation (1ms/DIV)

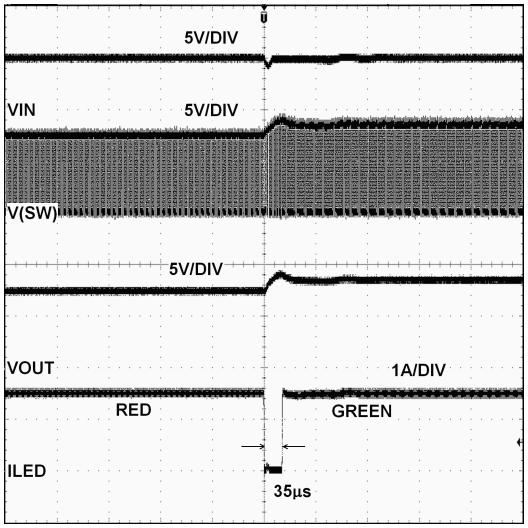

Figure 7. Color Transition Delay (100µs/DIV)

10 Bill of Materials

In order to help customer shorten the design cycle of the target application system, a detailed list of all components used in this evaluation board is provided.

ID	Part Number	Type	Size	Parameters	Qty	Su
U1	LM3435	RGB LED Driver IC	WQFN-40		1	Texas Instruments
SD1	RB160M-60	Schottky Diode	SOD-123	1A, 60V, Vf = 0.49V	1	Rohm
L1	CDMC6D28NP-2R2MC	Power Inductor	7mm x 7mm	2.2µH, 6A, 19mΩ	1	Sumida
C1, C9	GRM31CR61A476M	Ceramic Capacitor	1206	47µF, 10V, X5R	2	Murata
C2	GRM188R61E104K	Ceramic Capacitor	0603	0.1µH 25V, X5R	1	Murata
C3, C4A, C4B	GJ831CR61E106K	Ceramic Capacitor	1206	10µF, 25V, X5R	3	Murata
C5, C6, C7	GRM188R71H102K	Ceramic Capacitor	0603	1nF, 50V, X7R	3	Murata
C8	GRM188R71A105K	Ceramic Capacitor	0603	1µF, 10V, X7R	1	Murata
C10, C11. C12	GRM188R71E474K	Ceramic Capacitor	0603	0.47µF, 25V, X7R	3	Murata
R1, R2, R3		SMT Resistor	0603	16.5kΩ, ±1%	3	
R4		SMT Resistor	0603	499kΩ, ±1%	1	
R5, R6		SMT Resistor	0603	10kΩ, ±1%	2	
R7		SMT Resistor	0603	1kΩ, ±1%	1	
FAULT	LTST-C170EKT	SMT LED	0805	LED RED ORANGE	1	Lite-On
VIN, VOUT	1593–2	Terminal Pin	Φ2.35mm	Turret DBL, 2.34mm	1	Keystone
H1	B2PS-VH	Connector Header		2 Position, Pitch 3.96mm	1	JST
H2	B4PS-VH	Connector Header		4 Position, Pitch 3.96mm	1	JST
CON1	35363–0660	Connector Header		6 Position, Pitch 2mm	1	Molex
CON2	35363–0460	Connector Header		4 Position, Pitch 2mm	1	Molex

11 PCB Layout

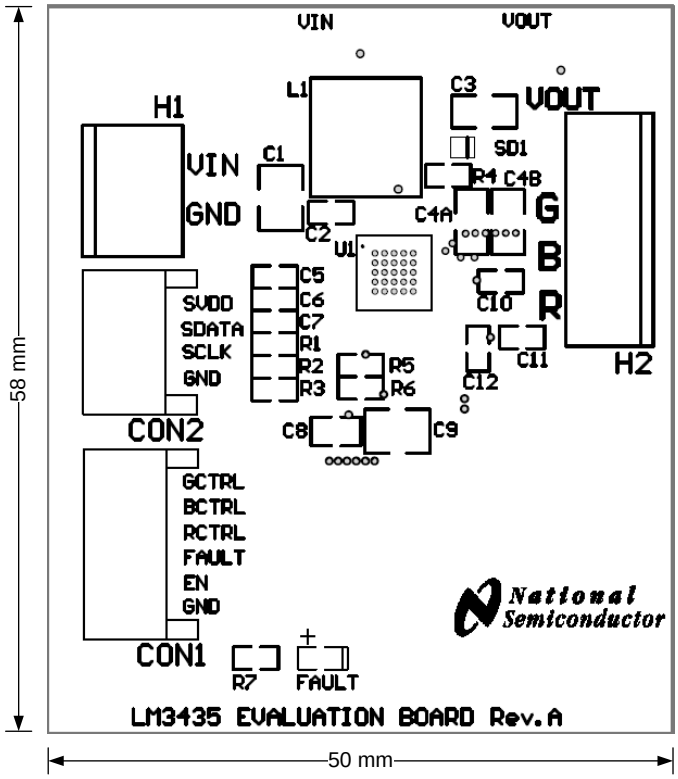

Figure 8. Top Overlay

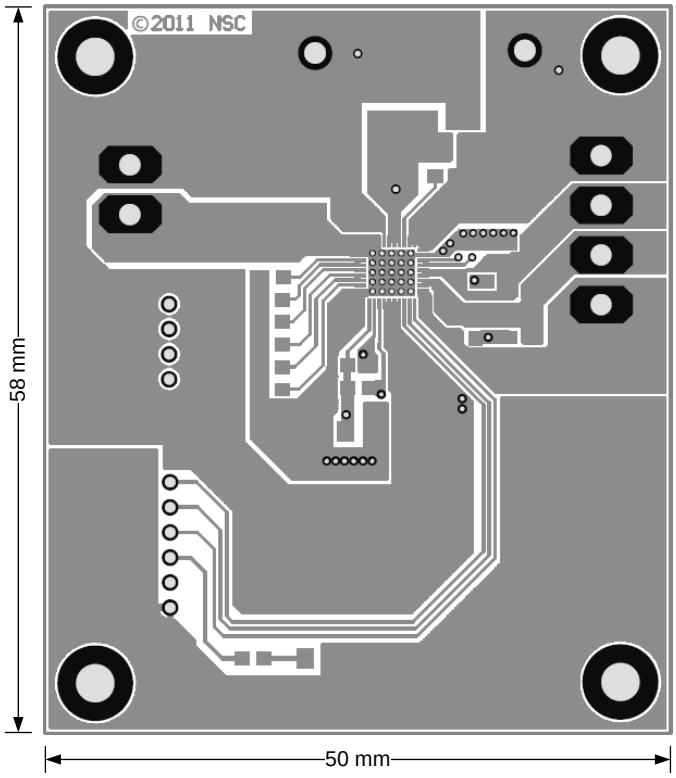

Figure 9. Top Layer

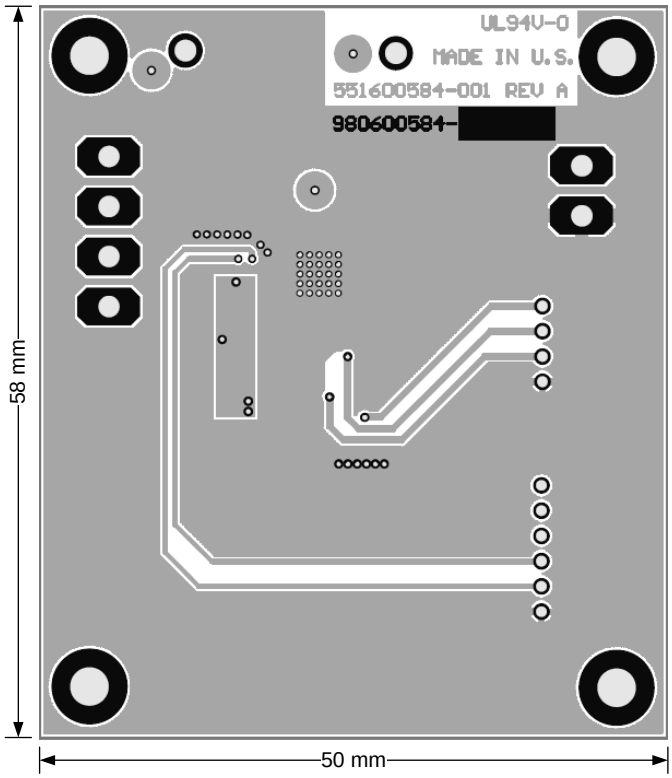

Figure 10. Bottom Layer

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- *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 dealer or an experienced radio/TV technician for help.*

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(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

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Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

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https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html

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Last updated 10/2025