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TF Semiconductor Solutions

TF2104M

Half-Bridge Gate Driver

Features

- **Floating high-side driver in bootstrap operation to 600V**
- **Drives two N-channel MOSFETs or IGBTs in a half bridge configuration**
- **Designed for enhanced performance in noisy motor applications**
- **290mA source/600mA sink output current capability**
- **Outputs tolerant to negative transients**
- **Internal dead time to protect MOSFETs**
- **Wide low side gate driver supply voltage: 10V to 20V**
- **Logic input (IN and SD*) 3.3V capability**
- **Schmitt triggered logic inputs**
- **Undervoltage lockout for V_{CC} (logic and low side supply)**
- **Extended temperature range: -40°C to +125°C**

Description

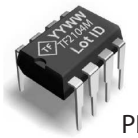
The TF2104M is a high voltage, high speed gate driver capable of driving N-channel MOSFETs and IGBTs in a half bridge configuration. TF Semi's high voltage process enables the TF2104M's high side to switch to 600V in a bootstrap operation.

The TF2104M logic inputs are compatible with standard TTL and CMOS levels (down to 3.3V) to interface easily with controlling devices. The driver outputs feature high pulse current buffers designed for minimum driver cross conduction.

The TF2104M is offered in PDIP-8 and SOIC-8(N) packages and operate over an extended -40 °C to +125 °C temperature range.

SOIC-8(N)





PDIP-8

Applications

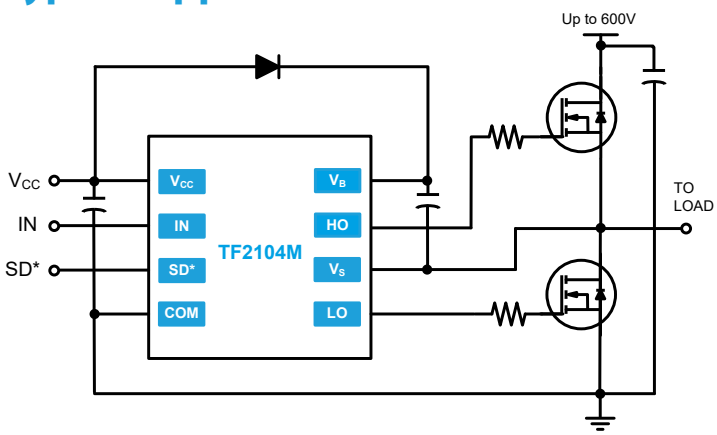
- Motor Controls
- DC-DC Converters
- AC-DC Inverters
- Motor Drives

Ordering Information

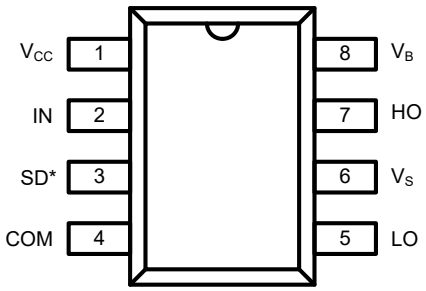
Year Year Week Week

PART NUMBER	PACKAGE	PACK / Qty	MARK
TF2104M-3AS	PDIP-8	Tube / 50	YYWW TF2104M Lot ID
TF2104M-TAU	SOIC-8(N)	Tube / 100	YYWW TF2104M Lot ID
TF2104M-TAH	SOIC-8(N)	T&R / 2500	

Typical Application



Pin Diagrams



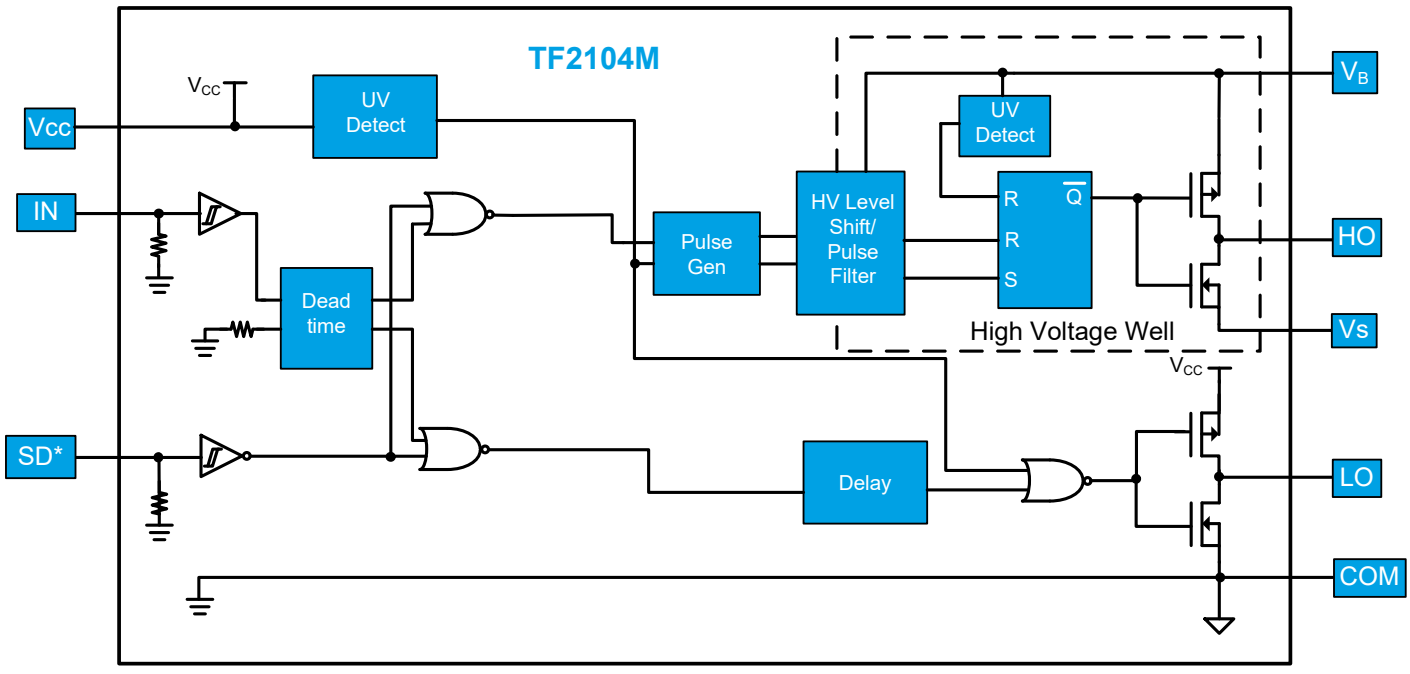
Top View: PDIP-8, SOIC-8

TF2104M

Pin Descriptions

PIN NAME	PIN NUMBER	PIN DESCRIPTION
V_{CC}	1	Logic and low side supply
IN	2	Logic input for high-side and low-side gate driver outputs (HO and LO), in phase with HO
SD*	3	Logic input for shutdown, enabled low
COM	4	Low-side and logic return
LO	5	Low-side gate drive output
V_S	6	High-side floating supply return
HO	7	High-side gate drive output
V_B	8	High-side floating supply

Functional Block Diagram



Absolute Maximum Ratings *(NOTE1)*

V_B - High side floating supply voltage.....-0.3V to +624V
V_S - High side floating supply offset voltage....V_B-24V to V_B+0.3V
V_{HO} - High side floating output voltage.....V_S-0.3V to V_B+0.3V
dV_S/dt - Offset supply voltage transient.....50 V/ns

V_{CC} - Low-side fixed supply voltage.....-0.3V to +24V
V_{LO} - Low-side output voltage.....-0.3V to V_{CC} +0.3V
V_{IN} - Logic input voltage (IN and SD*).....-0.3V to V_{CC} +0.3V

NOTE1 *Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

P_D - Package power dissipation at $T_A \leq 25$ °C
SOIC-8.....0.625W
PDIP-8.....1.0W

SOIC-8(N) Thermal Resistance ***(NOTE2)***
θ_{JA}.....200 °C/W
PDIP-8 Thermal Resistance ***(NOTE2)***
θ_{JA}.....125 °C/W

T_J - Junction operating temperature.....+150 °C
T_L - Lead Temperature (soldering, 10 seconds).....+300 °C
T_{stg} - Storage temerature .....-55 to 150 °C

NOTE2 *Thermal resistance and power dissipation ratings are measured under board mounted and still air conditions.*

Recommended Operating Conditions

Symbol	Parameter	MIN	MAX	Unit
V_B	High side floating supply absolute voltage	V_S + 10	V_S + 20	V
V_S	High side floating supply offset voltage	***NOTE3***	600	V
V_{HO}	High side floating output voltage	V_S	V_B	V
V_{CC}	Low side fixed supply voltage	10	20	V
V_{LO}	Low side output voltage	0	V_{CC}	V
V_{IN}	Logic input voltage (IN and SD*)	0	5	V
T_A	Ambient temperature	-40	125	°C

NOTE3 *Logic operational for V_S of -5V to +600V. Logic state held for V_S of -5V to $-V_{BS}$*

DC Electrical Characteristics *(NOTE4)*

V_{BIAS} (V_{CC}, V_{BS}) = 15V, T_A = 25 °C , unless otherwise specified.

Symbol	Parameter	Conditions	MIN	TYP	MAX	Unit
V_{IH}	Logic "1" (IN) & Logic "0" (SD*) input voltage	V_{CC} = 10V to 20V *NOTE5*	2.5			V
V_{IL}	Logic "0" (IN) & Logic "1" (SD*) input voltage				0.8	
V_{OH}	High level output voltage, V_{BIAS} - V_O	I_O = 2mA		0.05	0.2	
V_{OL}	Low level output voltage, V_O	I_O = 2mA		0.02	0.1	
I_{LK}	Offset supply leakage current	VB = VS = 600V			50	µA
I_{BSQ}	Quiescent V_{BS} supply current	V_{IN} = 0V or 5V		60	100	
I_{CCQ1}	Quiescent V_{CC} supply current	IN =0V or 5V, SD*=5V		350	500	
I_{CCQ2}	Quiescent V_{CC} supply current in shutdown	IN=0V or 5V, SD*=0V		590	750	
I_{IN+}	Logic "1" input bias current	IN = 5V, SD* = 0V		3	10	
I_{IN-}	Logic "0" input bias current	IN = 0V, SD* = 5V			5	
V_{CCUV+}	V_{CC} supply under-voltage positive going threshold		8.0	8.9	9.8	V
V_{CCUV-}	V_{CC} supply under-voltage negative going threshold		7.4	8.2	9.0	
V_{BSUV+}	V_{BS} supply under-voltage positive going threshold		4.5	5.5	6.5	V
V_{BSUV-}	V_{BS} supply under-voltage negative going threshold		4.2	5.2	6.2	V
I_{O+}	Output high short circuit pulsed current	V_O = 0V, PW ≤ 10 µs	130	290		mA
I_{O-}	Output low short circuit pulsed current	V_O = 15V, PW ≤ 10 µs	270	600		

NOTE4 *The V_{IN}, V_{TH}, and I_{IN} parameters are applicable to the two logic input pins: IN and SD*. The V_O and I_O parameters are applicable to the respective output pins: HO and LO*

NOTE5 *For optimal operation, it is recommended that the input pulse (to IN and SD*) should have an amplitude of 2.5V minimum with a pulse width of 840ns minimum*

AC Electrical Characteristics

V_{BIAS} (V_{CC}, V_{BS}) = 15V, C_L = 1000pF, and T_A = 25 °C , unless otherwise specified.

Symbol	Parameter	Conditions	MIN	TYP	MAX	Unit
t_{on}	Turn-on propagation delay	V_S = 0V		680	820	ns
t_{off}	Turn-off propagation delay	V_S = 600V		150	220	
t_{SD}	Shutdown propagation delay			160	220	
t_{DM}	Delay matching, HS & LS turn-on/turn-off				60	
t_r	Turn-on rise time	V_S = 0V		70	170	
t_f	Turn-off fall time			35	90	
t_{DT}	Deadtime: $t_{DT\ LO\text{-}HO}$ & $t_{DT\ HO\text{-}LO}$		300	420	650	

Timing Waveforms

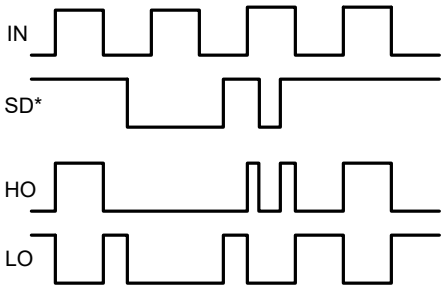


Figure 1. Input / Output Timing Diagram

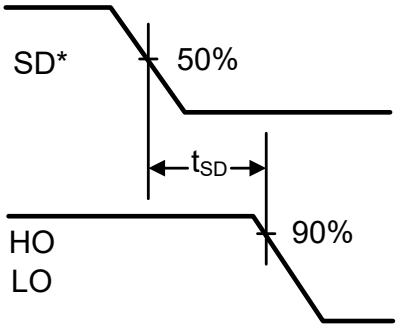
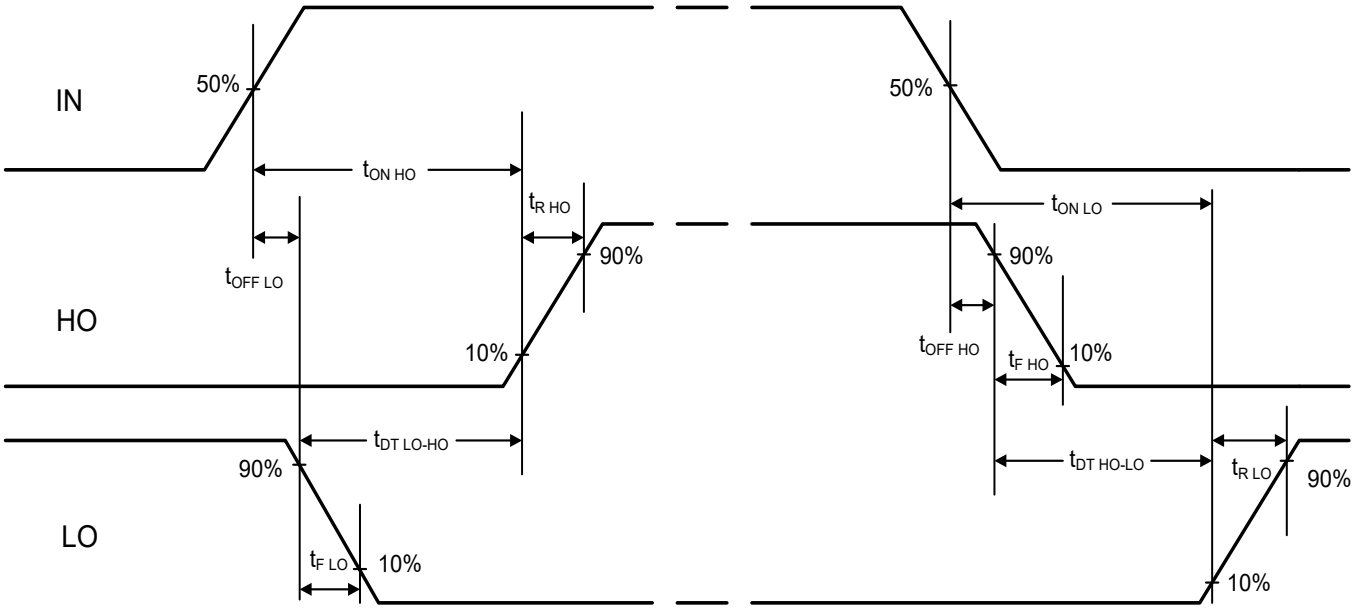


Figure 2. Shutdown Waveform Definition



Deadtime $t_{DT\ LO\text{-}HO} = t_{ON\ HO} - t_{OFF\ LO}$

$t_{DT\ HO\text{-}LO} = t_{ON\ LO} - t_{OFF\ HO}$

Deadtime matching

$t_{MDT} = t_{DT\ LO\text{-}HO} - t_{DT\ HO\text{-}LO}$

Delay matching

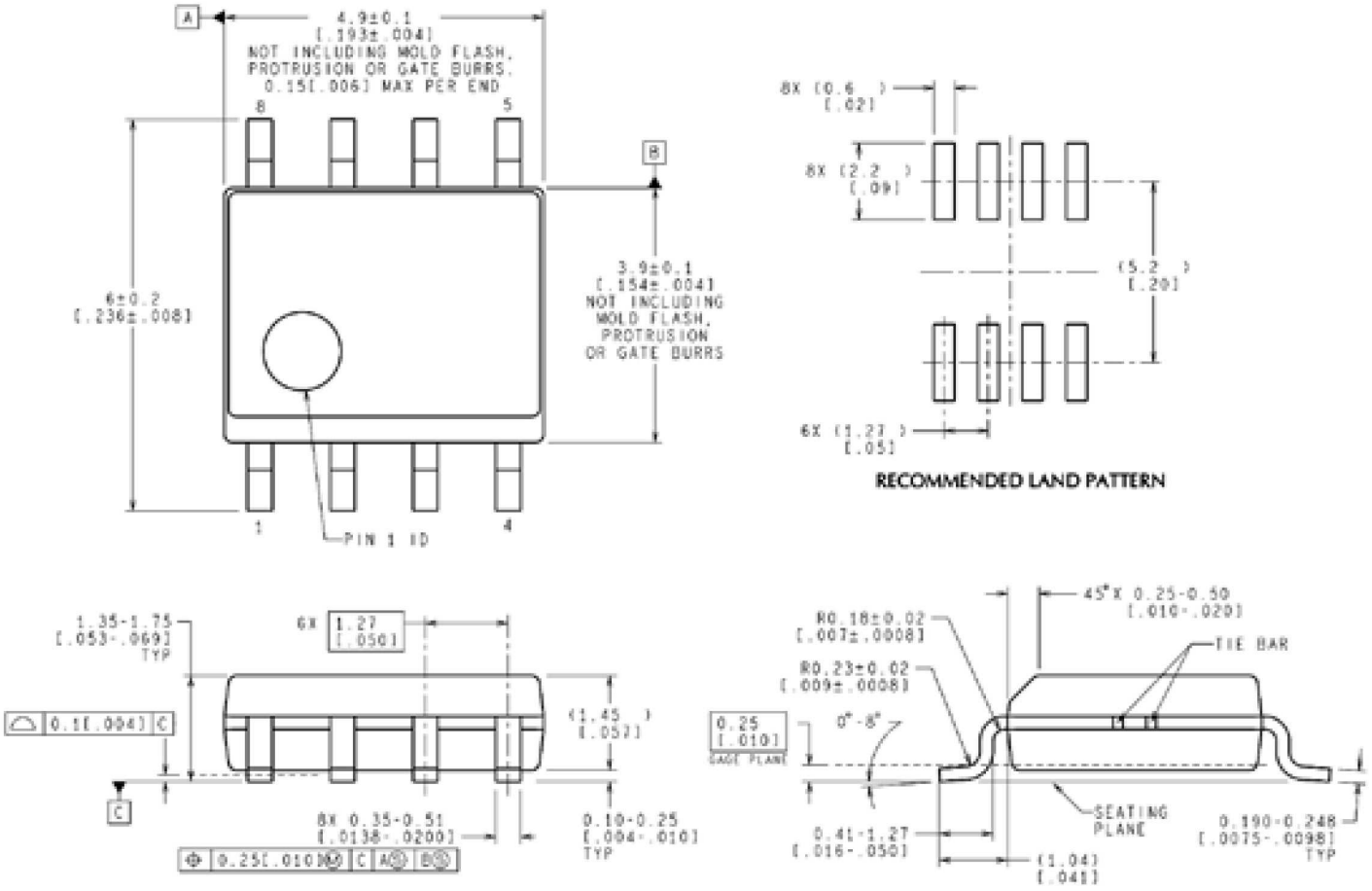
$t_{DM\ OFF} = t_{OFF\ LO} - t_{OFF\ HO}$

$t_{DM\ ON} = t_{ON\ LO} - t_{ON\ HO}$

Figure 3. Switching Time Waveform Definitions

Package Dimensions (SOIC-8 N)

Please contact support@tfsemi.com for package availability.



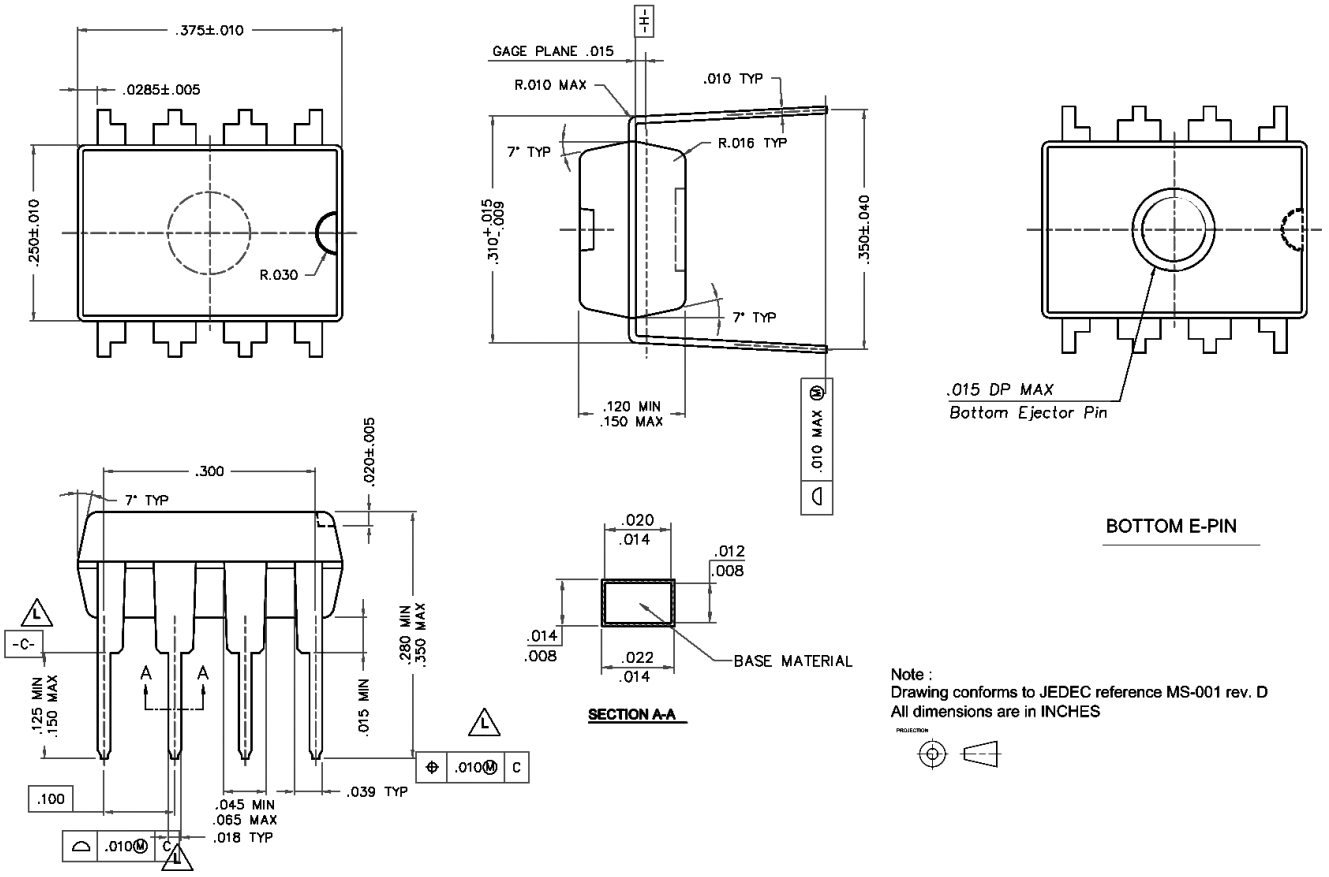
NOTES: UNLESS OTHERWISE SPECIFIED

1. REFERENCE JEDEC REGISTRATION MS-012, VARIATION AA.

CONTROLLING DIMENSION IS MILLIMETER
VALUES IN [ ] ARE INCHES
DIMENSIONS IN ( ) FOR REFERENCE ONLY

Package Dimensions (PDIP-8)

Please contact support@tfsemi.com for package availability.



Revision History

Rev.	Change	Owner	Date
1.0	First release, Advance Info datasheet	Keith Spaulding	6/2/2016
1.1	VBS UVLO added to specifications	Keith Spaulding	6/23/2016
1.2	Corrected Functional Block diagram	Keith Spaulding	3/18/2019
1.3	Add Note 5	Duke Walton	7/18/2019

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