

Features

- 10 V to 180 V Bias
- 600 mA Sinking Current on Series Outputs
- 100 mA Sinking Current on Shunt Outputs
- Propagation Delay <5 μ s Driving 1200 pF Capacitive Load
- Quiescent Current <0.4 mA
- Internal Low Voltage Bias eliminates need for external 5 V supply
- TTL Logic Control
- 6 mm 18-Lead PQFN Package
- RoHS* Compliant

Applications

- Land Mobile Radio
- MILCOM

Description

The MADR-011021 four channel switch driver is designed to work with MACOM's Series/Shunt SP4T PIN diode switches (e.g., MASW-011077). This driver has 1 series output and 1 shunt output per channel which can provide up to 600 mA sinking (series), 100 mA sinking (shunt), and 5 mA sourcing bias current.

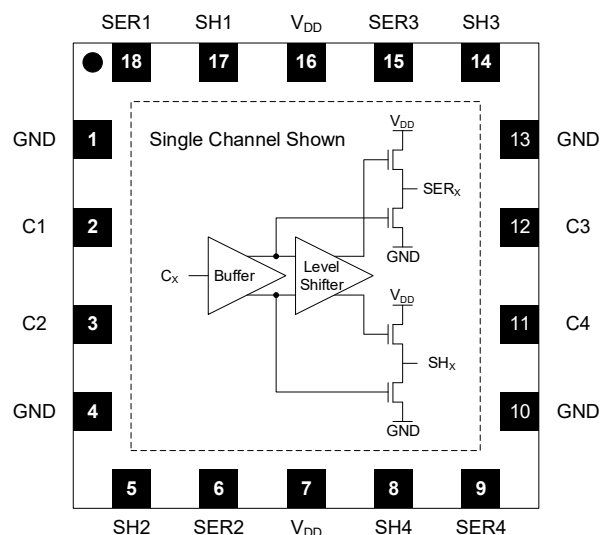
The bias voltage can be selected to be any voltage between 10 V to 180 V. This switch driver can be easily controlled by standard TTL logic. With low quiescent current of <0.4 mA, this driver has a typical delay of <5 μ s when driving a 1200 pF capacitive load.

This driver is packaged in a lead-free 6 mm 18-lead PQFN package and is available in tape and reel packaging for high volume applications.

Ordering Information

Part Number	Package
MADR-011021	bulk
MADR-011021-TR0500	500 piece reel
MADR-011021-SMB	Sample Board

Functional Schematic



Pin Configuration

Pin #	Function	Description of Function
1,4,10,13	GND ¹	Ground
2	C1	Control 1 Input
3	C2	Control 2 Input
5	SH2	Shunt 2 Output
6	SER2	Series 2 Output
7,16	V _{DD}	Driver Bias Voltage
8	SH4	Shunt 4 Output
9	SER4	Series 4 Output
11	C4	Control 4 Input
12	C3	Control 3 Input
14	SH3	Shunt 3 Output
15	SER3	Series 3 Output
17	SH1	Shunt 1 Output
18	SER1	Series 1 Output
19	Paddle ²	Ground

1. All GND pins are internally connected and must be connected externally to system ground.
2. The exposed pad centered on the package bottom must be connected to DC and thermal ground.

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

Electrical Specifications: $T_A = 25^\circ\text{C}$, $V_{DD} = 150\text{ V}$, $C1 = C2 = C3 = C4 = 5\text{ V}$

Parameter	Test Conditions	Units	Min.	Typ.	Max.
V_{DD} Quiescent Current	—	μA	—	225	500
$R_{\text{PULL-UP}}$, Series/Shunt Pull-up FET On Resistance	5 mA Load	Ω	—	87	—
$R_{\text{PULL-DOWN}}$, Series Pull-down FET On Resistance	600 mA Load	Ω	—	1.7	2.0
$R_{\text{PULL-DOWN}}$, Shunt Pull-down FET On Resistance	100 mA Load	Ω	—	6.3	10
Switching Speed Driving 1200 pF: Series ³ T_{ON} T_{OFF} T_{RISE} T_{FALL}	50% control to 95% Voltage 50% control to 5% Voltage 5% to 95% Voltage 95% to 5% Voltage	μs	—	3.0 0.8 2.3 0.4	—
Switching Speed Driving 1200 pF: Shunt ³ T_{ON} T_{OFF} T_{RISE} T_{FALL}	50% control to 95% Voltage 50% control to 5% Voltage 5% to 95% Voltage 95% to 5% Voltage	μs	—	1.8 1.2 1.6 0.6	—
Switching Speed Driving MASW-011077 ⁴ T_{ON} T_{OFF} T_{RISE} T_{FALL}	50% control to 90% RF 50% control to 10% RF 10% to 90% RF 90% to 10% RF	μs	—	9.3 4.6 4.9 2.6	—
Driver Power Up Time	Note 5	μs	—	2	—
Driver Power Down Time	Note 6	μs	—	2	—

3. Tested with a 1200 pF capacitive load (no current load). The control input switched between 0.8 V and 2.0 V with a 5 ns rise/fall time.
4. Tested with MASW-011077 as the load with a 100 Hz repetition rate in Commutating Mode (RFC - RF1/RF2) with a 0 dBm, 500 MHz RF input. The control inputs switched between 0.8 V and 2.0 V with a 5 ns rise/fall time. $V_{DD} = 150\text{ V}$.
5. This is the time needed for the driver to function properly after V_{DD} reaches 90% of its stable value
6. This is the time needed for the internal bias voltages to discharge to 10% of their steady state value after V_{DD} is powered down.

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices. The device has an ESD ratings for HBM Class 2 (2kV), and CDM Class C3 (1000 V).

Recommended Operating Conditions^{7,8}

Parameter	Test Conditions	Units	Min.	Typ.	Max.
V_{DD}	—	V	10	—	180
C1, C2, C3, C4	Logic "0" Logic "1"	V	0.0 2.0	0.0 5	0.8 5.5
I_{SOURCE} , Series/Shunt Sourcing Current per Output	—	mA	—	—	5
I_{SINK} , Series Sinking Current per Output	—	mA	—	—	600
I_{SINK} , Shunt Sinking Current per Output	—	mA	—	—	100
Total Capacitive load per Output	—	pF	—	—	4000
Repetition Rate	—	Hz	—	100	—
Operating Temperature	—	°C	-40	+25	+85

7. MACOM recommends placing a 0.1 μ F capacitor between V_{DD} and ground close to the driver. Care should be taken to ensure proper voltage rating of this capacitor.
8. Unused channels should have their control logic input tied to ground with the corresponding series and shunt outputs left open.

Absolute Maximum Ratings^{9,10,12}

Parameter	Absolute Maximum
V_{DD}	$-0.3 \text{ V} \leq V_{DD} \leq +190 \text{ V}$
Controls	$-0.3 \text{ V} \leq \text{Controls} \leq +7 \text{ V}$
Series Outputs Sinking Current	650 mA
Shunt Outputs Sinking Current	150 mA
Series/Shunt Outputs Sourcing Current	10 mA
Capacitive Load per Output ¹¹	4500 pF
Maximum Repetition Rate	150 Hz
Operating Temperature	-40°C to +110°C
Storage Temperature	-55°C to +150°C
Junction Temperature (T_J)	+125°C

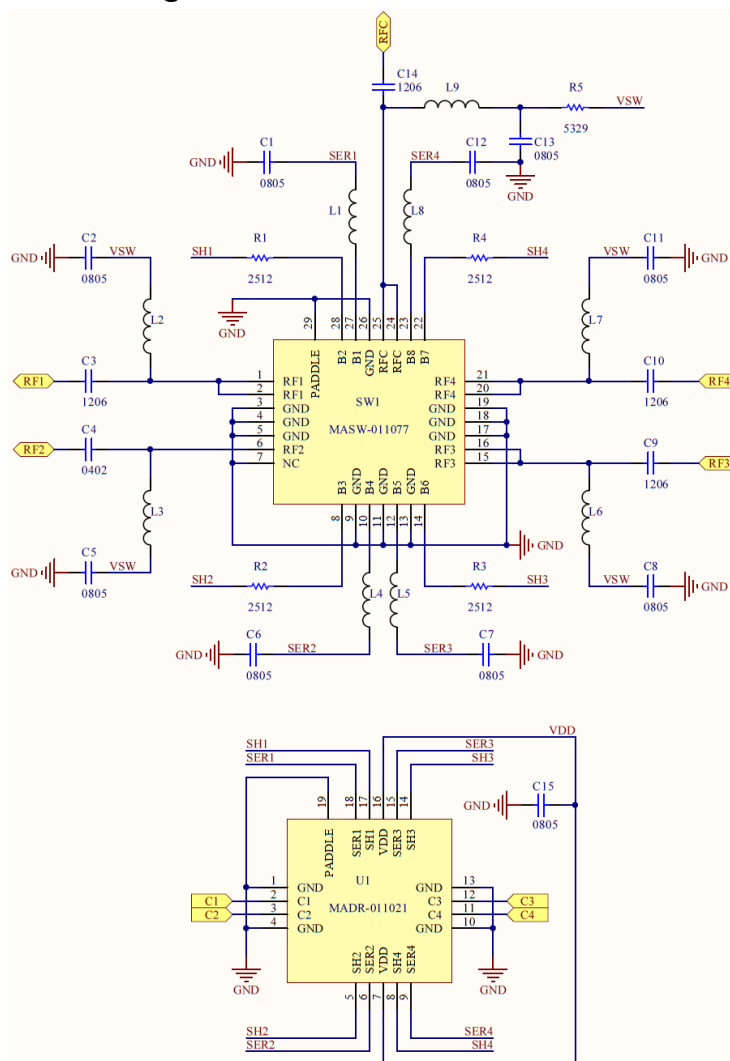
9. Exceeding any one or combination of these limits may cause permanent damage to this device.
10. MACOM does not recommend sustained operation near these survivability limits.
11. Capacitive load above 4500 pF can cause peak currents exceeding the power limit for the MOSFETs in the output buffers.
12. Thermal resistance junction to case $\theta_{JC} = 25^\circ\text{C/W}$.

Logic Truth Table per Channel^{13,14,15,16}

C_x	SER_x	SH_x
0	L	H
1	H	L

13. The actual output low voltage can be calculated by:
 $V_{OL} = I_{SINK} \times R_{PULL-DOWN}$.
14. The actual output high voltage can be calculated by:
 $V_{OH} = V_{DD} - I_{SOURCE} \times R_{PULL-UP}$.
15. ' C_x ' represents C1, C2, C3, or C4.
16. ' SER_x ' and ' SH_x ' represent the corresponding outputs to ' C_x ', e.g., C1 and SER1 and SH1.

Application Schematic Driving MASW-011077



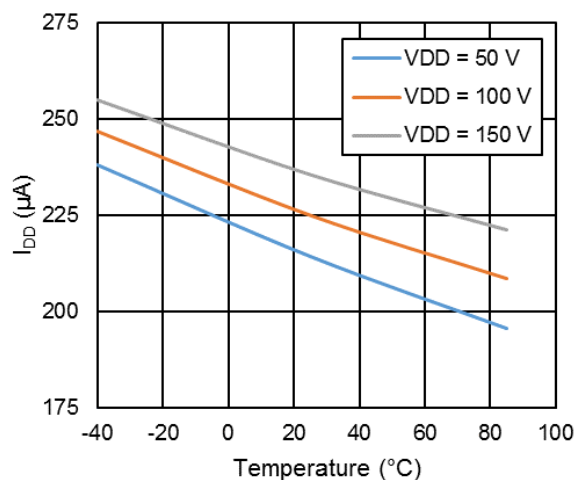
17. A VDD RC filtering network is optional but not a requirement for this driver.

Parts List

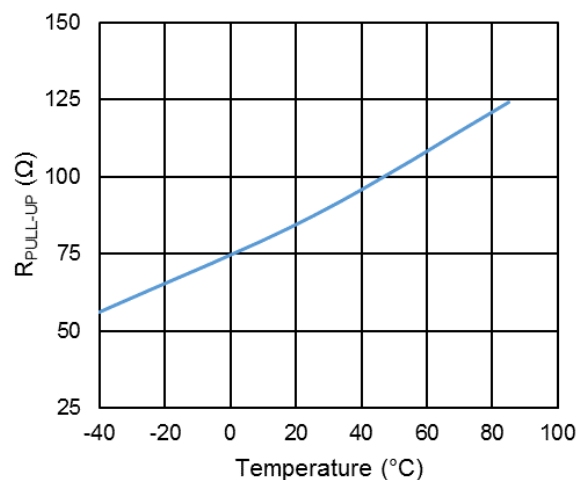
Part	Value
U1	MADR-011021, MACOM, 10 V to 180 V Driver
SW1	MASW-011077, MACOM, SP4T Switch
L1 - L9	Inductor, 520 nH, MCI, 22-6042-CCPAS-27-42-48
R1 - R4	Resistor, 82 Ω , 2512, 1%, 2 W
R5	Resistor, 9.1 Ω , 5329, 5%, 5 W
C1, C2, C5, C6, C7, C8, C11, C12, C13	Capacitor, 1000 pF, 0805, 5%, 250 V
C3, C9, C10, C14	Capacitor, 270 pF, 1206, 5%, 200 V
C4	Capacitor, 270 pF, 0402, 5%, 50 V
C15	Capacitor, 0.1 μ F, 0805, 10%, 250 V

Typical Performance Curves¹⁶

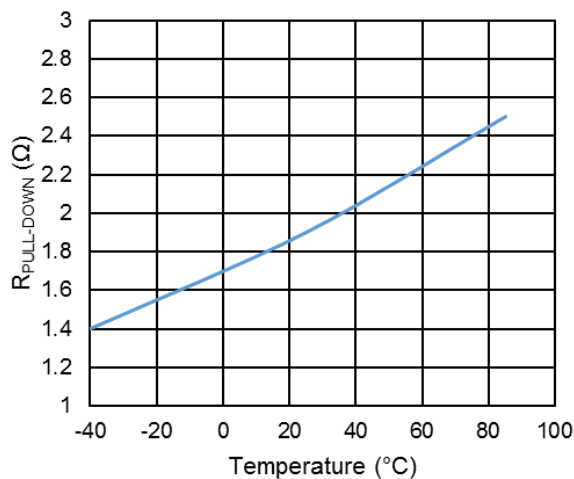
Quiescent I_{DD} : All Controls = +5 V



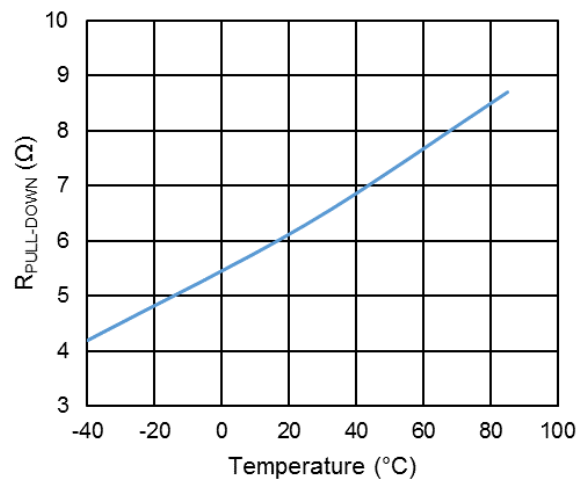
Series/Shunt Pull-Up On Resistance¹⁷



Series Pull-Down On Resistance¹⁷



Shunt Pull-Down On Resistance¹⁷

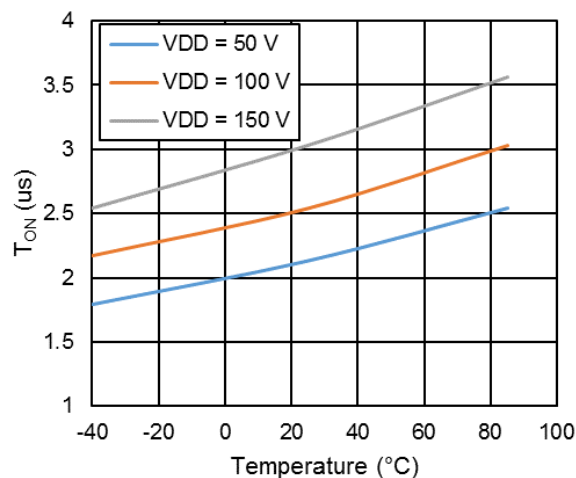


16. $V_{DD} = 150$ V unless otherwise specified.

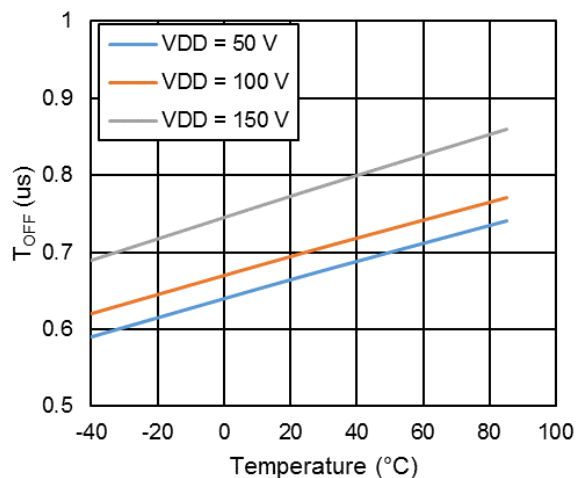
17. Pull-Up and Pull-Down On Resistances do not change with different V_{DD} levels.

Typical Performance Curves¹⁸

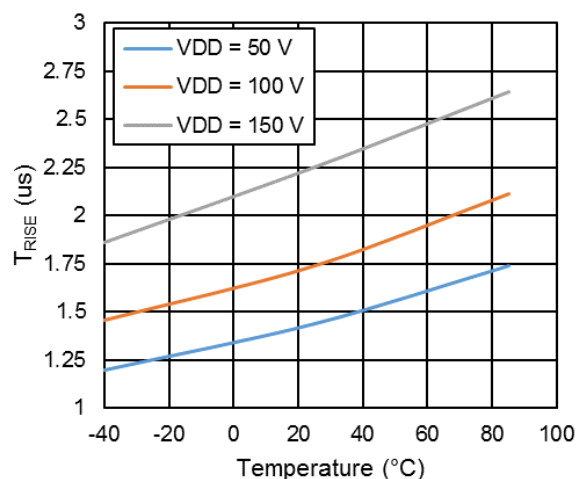
Series Switching Speed Driving 1200 pF Capacitors:
 T_{ON}



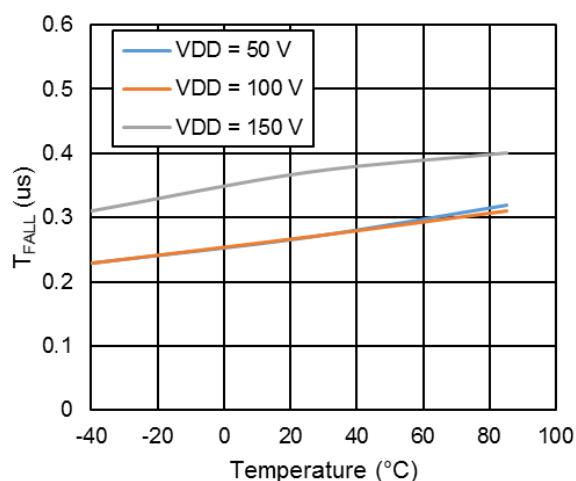
Series Switching Speed Driving 1200 pF Capacitors:
 T_{OFF}



Series Switching Speed Driving 1200 pF Capacitors:
 T_{RISE}



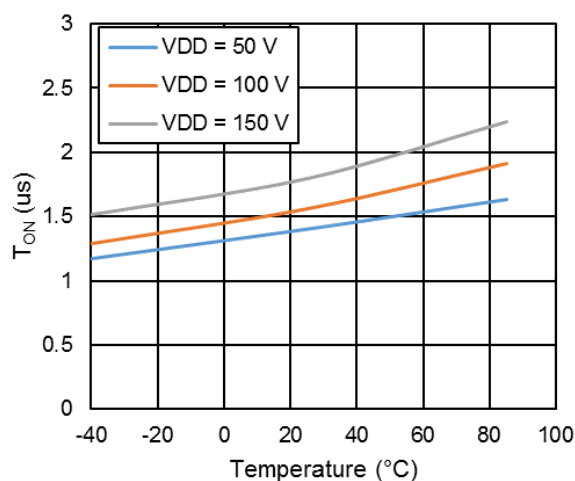
Series Switching Speed Driving 1200 pF Capacitors:
 T_{FALL}



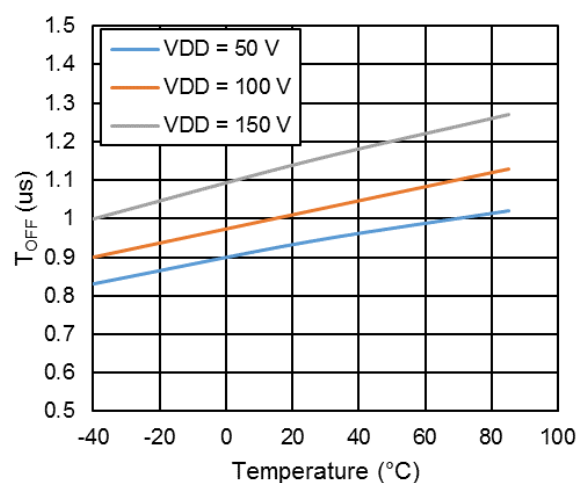
18. Tested with a 1200 pF capacitive load (no current load). The control input switched between 0.8 V and 2.0 V with a 5 ns rise/fall time.

Typical Performance Curves¹⁹

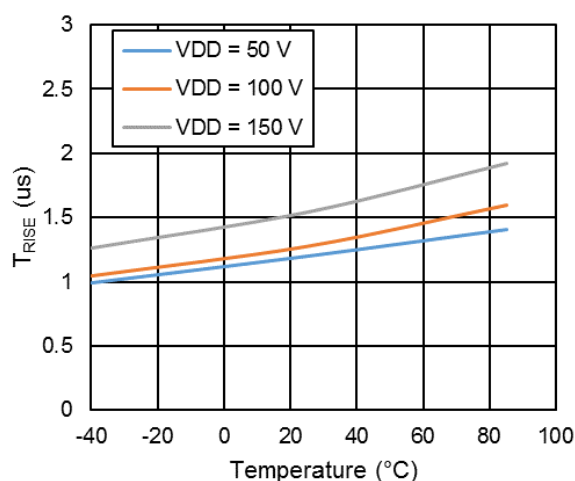
Shunt Switching Speed Driving 1200 pF Capacitors:
 T_{ON}



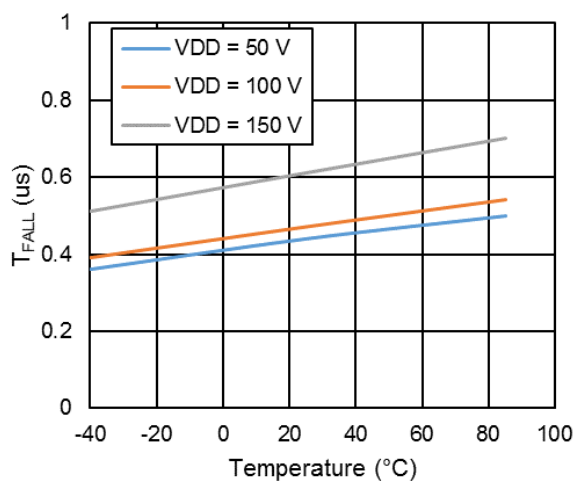
Shunt Switching Speed Driving 1200 pF Capacitors:
 T_{OFF}



Shunt Switching Speed Driving 1200 pF Capacitors:
 T_{RISE}



Shunt Switching Speed Driving 1200 pF Capacitors:
 T_{FALL}

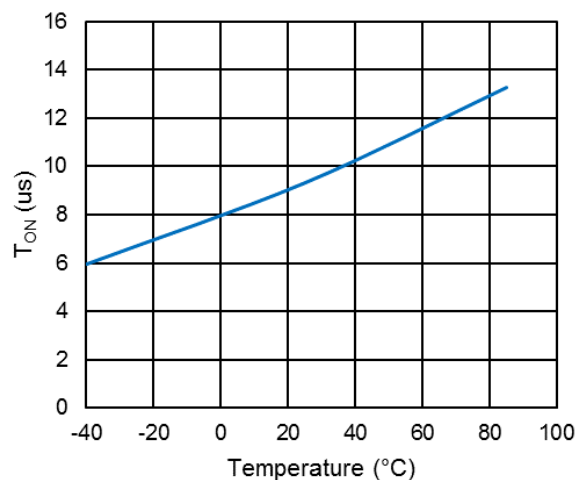


19. Tested with a 1200 pF capacitive load (no current load). The control input switched between 0.8 V and 2.0 V with a 5 ns rise/fall time.

Typical Performance Curves²⁰

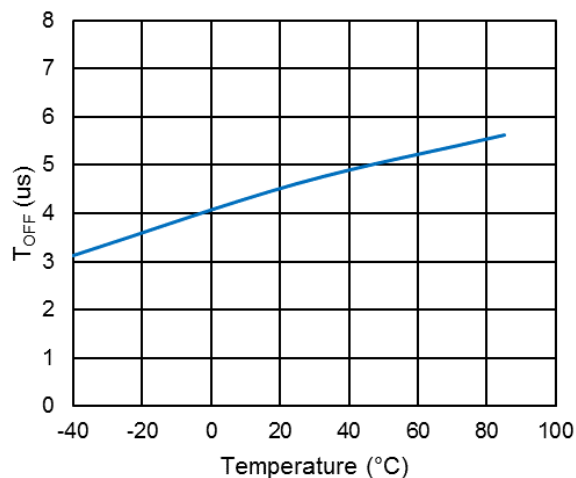
Switching Speed Driving MASW-011077 Switch:

T_{ON}



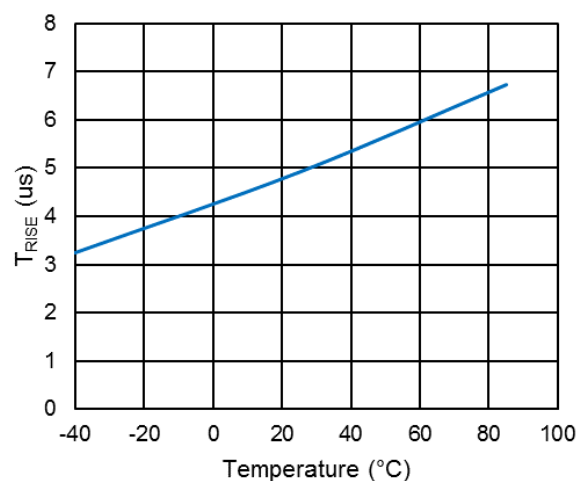
Switching Speed Driving MASW-011077 Switch:

T_{OFF}



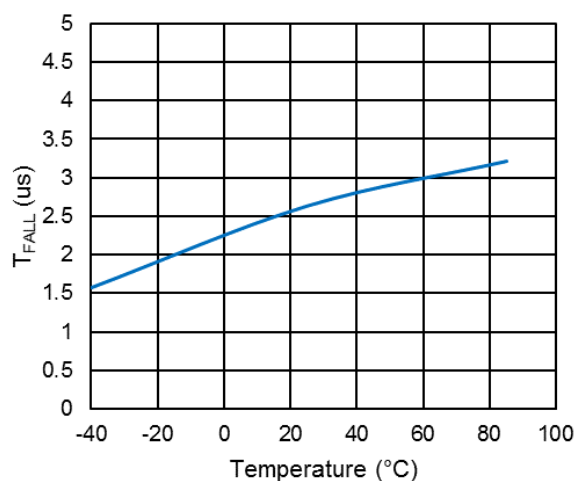
Switching Speed Driving MASW-011077 Switch:

T_{RISE}



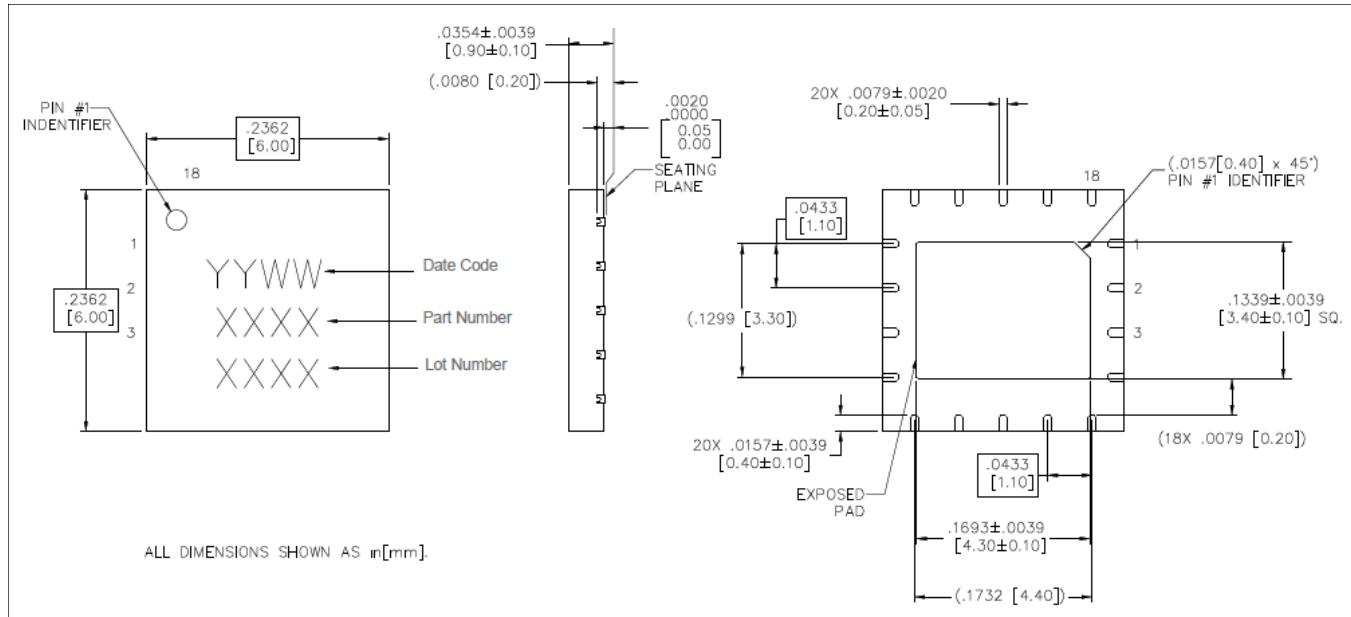
Switching Speed Driving MASW-011077 Switch:

T_{FALL}



20. Tested with MASW-011077 as the load with a 100 Hz repetition rate in Commutating Mode (RFC - RF1/RF2) with a 0 dBm, 500 MHz RF input. The control inputs switched between 0.8 V and 2.0 V with a 5 ns rise/fall time. $V_{DD} = 150$ V.

Lead-Free 6 mm 18-Lead PQFN[†]



† This is not a JEDEC standard package.
JEDEC moisture sensitivity level MSL 3.
Plating is NiPdAuAg.

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