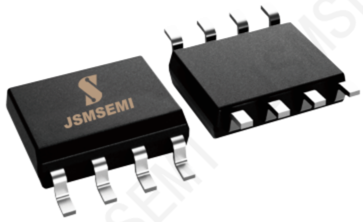
General description

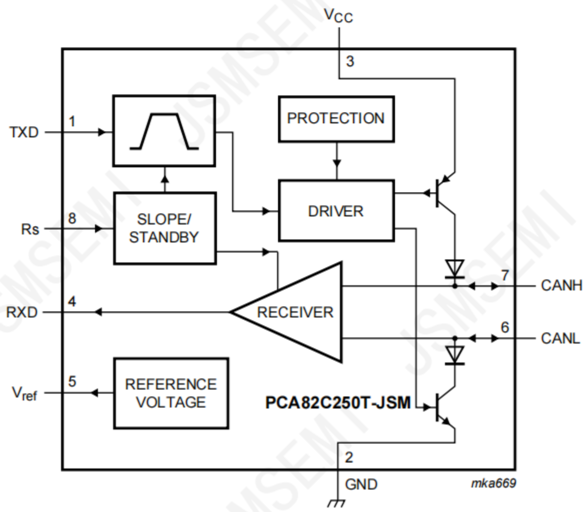
The PCA82C250T is the interface between a CAN protocol controller and the physical bus. The device provides differential transmit capability to the bus and differential receive capability to the CAN controller, with signaling rates up to 5Mbps. The device is intended for use in applications employing the CANserial communication physical layer in accordance with the ISO 11898 standard.



Features and benefits

- Fully compatible with the " ISO 11898-24V" standard
- High speed (up to 5 MBd)
- Bus lines protected against transients in an automotive environment
- Slope control to reduce Radio Frequency Interference (RFI)
- High immunity against electromagnetic interference
- Open Circuit Fail-Safe Design
- Thermally protected
- Short-circuit proof to battery and ground
- Low-current Standby mode
- An unpowered node does not disturb the bus lines
- At least 110 nodes can be connected
- Short-circuit proof to battery and ground in 24V powered systems

Block diagram



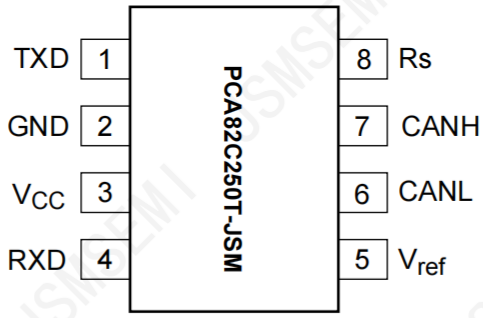
Applications

- High-speed automotive applications
- Industrial Automation, Sensors and Drive Systems
- Motor and Robotic Control
- Building and Climate Control (HVAC)
- Telecommunications and Base Station Control and Status
- CAN Bus Standards Such as CAN open

Ordeing Infomation

Ordernumber	Package	Marking	Operation Temperature Range	MSL Grade	Ship,Quantity	Green
PCA82C250T/YM,118-JSM	SOP-8	JSM82C250T	-40 to 125°C	3	T&R,2500	Rohs

Pinning information



Pin configuration

Pin		Type	Description
Name	**No.**		
TXD	1	I	CAN transmit data input (LOW for dominant and HIGH for recessive bus states), driver input
GND	2	GND	Ground connection
V_{CC}	3	Supply	Transceiver 5V supply Voltage
RXD	4	O	CAN receive data output (LOW for dominant and HIGH for recessive bus states)
V_{ref}	5	O	V_{CC} /2 reference output pin
CANL	6	I/O	Low level CAN bus line
CANH	7	I/O	High level CAN bus line
Rs	8	I	Slope resistor input

Functional description

The JSM80C250T is the interface between a CAN protocol controller and the physical bus.It is primarily intended for applications up to 5MBd in trucks and buses. The device provides differential transmit capability to the bus and differential receive capability to the CAN controller. It is fully compatible with the “ISO 11898-24V”standard. A current-limiting circuit protects the transmitter output stage against short-circuits to positive and negative battery voltage. Although power dissipation will increase as a result of a short circuit fault condition, this feature will prevent destruction of the transmitter output stage.

If the junction temperature exceeds approximately 150°C, the limiting current of both transmitter outputs is decreased. Because the transmitter is responsible for most of the power dissipated, this will result in reduced power dissipation and hence a lower chip temperature. All other parts of the IC will remain operational. The thermal protection is needed, in particular, when a bus line is shortcircuited.

The CANH and CANL lines are also protected against electrical transients which may occur in an automotive environment.
Pin 8 (Rs) allows three different modes of operation to be selected: High-speed, Slope control and Standby.
For high-speed operation, the transmitter output transistors are simply switched on and off as fast as possible.
In this mode, no measures are taken to limit the rise and fall slopes. A shielded cable is recommended to avoid RFI problems. High-speed mode is selected by connecting pin 8 to ground.
Slope control mode allows the use of an unshielded twisted pair or a parallel pair of wires as bus lines. To reduce RFI,the rise and fall slopes should be limited. The rise and fall slopes can be programmed with a resistor connected from pin 8 to ground. The slope is proportional to the current output at pin 8.
If a HIGH level is applied to pin 8, the circuit enters a low-current Standby mode. In this mode, the transmitter is switched off and the receiver is switched to a low current. If dominant bits are detected (differential bus voltage >0.9 V), RXD will be switched to a LOW level. The microcontroller should react to this condition by switching the transceiver back to normal operation (via pin 8). Because the receiver is slower in Standby mode, the first message will be lost at higher bit rates.

Table 1. Truth table of the CAN transceiver

Supply	TXD	CANH	CANL	Bus state	RXD
4.5V to 5.5V	0	HIGH	LOW	dominant	0
4.5V to 5.5V	1 (or floating)	floating	floating	recessive	1
<2V (not powered)	X[1]	floating	floating	recessive	X
2V < V_{cc} < 4.5V	>0.75V_{CC}	floating	floating	recessive	X
2V < V_{cc} < 4.5V	X	floating if V_{Rs} > 0.75V_{CC}	floating if V_{Rs} > 0.75V_{CC}	recessive	X

Table 2.Pin Rs summary

Condition	Mode	Resulting voltage or current at pinRs
V_{Rs} > 0.75V_{CC}	Standby	Rs < |10μA|
-10μA< I_{Rs} < -200μA	Slope control	0.4V_{CC} < V_{Rs} < 0.6V_{CC}
V_{Rs} < 0.3V_{CC}	High-speed	I_{Rs} < -500μA

Specifications

Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1)All voltages are referenced to pin 2(GND); positive input current.

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	Supply Voltage		-0.3	+6.5	V
V_n	DC voltage at pins 1,4,5 and 8		-0.3	V_{CC}+0.3	V
$V_{6,7}$	Voltage at any bus terminal (CANH or CANL)	0V<VCC<5.5V; TXD HIGH or floating	-40	+40	V
V_{trt}	Transient voltage at pins 6 and 7	See Figure 6	-180	+180	V
T_{stg}	Storage temperature		-50	+150	°C
T_{amb}	Ambient temperature		-40	+125	°C
T_{vj}	Virtual junction temperature	[2]	-40	+150	°C
VESD	Electrostatic discharge voltage	CANH,CANL and GND (HBM)	-16000	+16000	V
		Charged-device model (CDM)	-1000	+1000	V

(1) 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 under Recommended Operating Conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

(2) An alternative definition of virtual junction temperature is: Tvj = Tamb + Pd × Rth(vj-a), where Rth(j-a) is a fixed value to be used for the calculation of Tvj. The rating for Tvj limits the allowable combinations of power dissipation (Pd) and ambient temperature(Tamb).

Recommended Operating Conditions

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	Supply voltage		4.5	5.5	V
I_{CC}	Supply current	Standby mode	-	600	μA
$1/t_{bit}$	Maximum transmission speed	Non-return-to-zero	-	5	MBd
V_{CAN}	CANH, CANL input/output voltage		-40	+40	V
V_{diff}	Differential bus voltage		1.5	3.0	V
t_{PD}	Propagation delay	High-speed mode	-	60	ns
T_{amb}	Ambient temperature		-40	+125	°C

Thermal Data

Symbol	Parameter	Conditions	Typ	Unit
Rth(j-a)	thermal resistance from junction to ambient	In free air	165	K/W

Electrical Characteristics: Driver

over recommended operating conditions (unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{IH}	HIGH-level input voltage	Output recessive	$0.7V_{CC}$	-	$V_{CC}+0.3$	V
V_{IL}	LOW-level input voltage	Output dominant	-0.3	-	$0.3V_{CC}$	V
I_{IH}	HIGH-level input current	V_I = 2V	–10	-2.5	10	μA
I_{IL}	LOW-level input current	V_I = 0.8V	–10	-6.0	15	μA
$V_{CANH/L}$	Recessive bus voltage	V_I = 3V; no load	2.0	-	3.0	V
I_{LO}	Off-state output leakage current	$V_{CANH/L}$= 7V， V_{CC} = 0V	100	-	350	μA
		$V_{CANH/L}$= -2V， V_{CC} = 0V	-100	-	-20	μA
V_{CANH}	CANH output voltage	V_I = 1V	2.75	-	4.5	V
V_{CANL}	CANL output voltage	V_I = 1V	0.5	-	2.25	V
△$V_{CANH/L}$	Difference between output voltage at pins CANL and CANH	V_I = 1V	1.5	-	3.0	V
		V_I = 1V; R_L= 45Ω; V_{CC} ≥ 4.5V	1.5	-	-	V
		V_I = 3V; no load	-500	-	+50	mV
I_{OS}	Short-circuit CANH current	V_{CANH} = -5V	-	-	-250	mA
		V_{CANH} = -32V	-	-100	-	mA
	Short-circuit CANL current	V_{CANL} = 32V	-	-	250	mA

Electrical Characteristics: Receiver

over recommended operating conditions (unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{diff(r)}$	Differential input voltage(recessive)	-2V<$V_{CANH/L}$<7V, non-Standy mode	-1.0	-	+0.5	V
			-1.0	-	+0.4	V
$V_{diff(d)}$	Differential input voltage(dominant)	-2V<$V_{CANH/L}$<7V, non-Standy mode	0.9	-	5.0	V
			1.0	-	5.0	V
$V_{diff(hys)}$	Differential input hysteresis	See Figure 3	-	160	-	mV
V_{OH}	HIGH-level output voltage	Pin4; I_{RXD} = -100μA	$0.8V_{CC}$	-	V_{CC}	V
V_{OL}	LOW-level output voltage	Pin4; I_{RXD} = 1mA	0	-	$0.2V_{CC}$	V
		I_{RXD} =10mA	0	-	1.5	V
R_i	Input resistance	CANH, CANL	4.7	-	30	kΩ
R_{diff}	Differential input resistance		40	70	100	kΩ
C_i	Input capacitance	CANH, CANL	-	-	20	pF
C_{diff}	Differential input capacitance		-	-	10	pF

Characteristics

over recommended operating conditions (unless otherwise noted)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Power Supply consumption						
I_{CC}	Supply current	Dominant; V_I =1V; Vcc=5V	-	-	2	mA
		Recessive; V_I = 3V; R_{RS} = 47kΩ	-	-	2	mA
		Standby;Tamb<80°C	-	400	600	μA
Reference output						
Vref	Reference output voltage	5μA < $I_{(Vref)}$ < 5μA	$0.45V_{CC}$	-	$0.55V_{CC}$	V
		-50μA< $I_{(Vref)}$ < 50μA	$0.4V_{CC}$	-	$0.6V_{CC}$	V
Timing (CL = 100pF; see Figure 1, Figure 2, Figure 4 and Figure 5)						
t_{PLH}	Propagation delay time,low-to-high-level output	$V_{(Rs)}$ = 0V	-	55	85	ns
		Rs with 10kΩ to ground	-	80	125	ns
		Rs with 100kΩ to ground	-	110	160	ns
t_{PHL}	Propagation delay time,high-to-low-level output	$V_{(Rs)}$ = 0V	-	80	120	ns
		Rs with 10kΩ to ground	-	130	180	ns
		Rs with 100kΩ to ground	-	170	240	ns
$t_{sk(p)}$	Pulse skew ($\lvert t_{PHL} - t_{PLH} \rvert$)	$V_{(Rs)}$ = 0V	-	100	200	ns
		Rs with 10kΩ to ground	-	300	450	ns
		Rs with 100kΩ to ground	-	450	580	ns
t_r	Differential output signal rise time	$V_{(Rs)}$ = 0V	-	280	350	ns
t_f	Differential output signal fall time		-	280	500	ns
t_r	Differential output signal rise time	Rs with 100kΩ to ground	-	230	350	ns
t_f	Differential output signal fall time		-	10	-	V/μs
t_r	Differential output signal rise time	Rs with 10kΩ to ground	-	-	25	μs
t_f	Differential output signal fall time		-	-	8	μs
Standby/Slope Control (pin 8)						
V_{RS}	Input voltage for high-speed		-	-	$0.3V_{CC}$	V
I_{RS}	Input current for high-speed	V_{RS} = 0V	-	-	-450	μA
V_{stb}	Input voltage for Standby mode		$0.75V_{CC}$	-	-	V
I_{slope}	Slope control mode current		-10	-	-200	μA
V_{slope}	Slope control mode voltage		$0.4V_{CC}$	-	$0.6V_{CC}$	V

Parameter Measurement Information

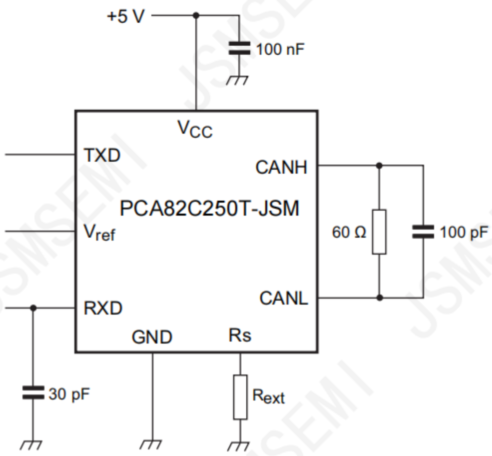


Figure 1. Test circuit for dynamic characteristics.

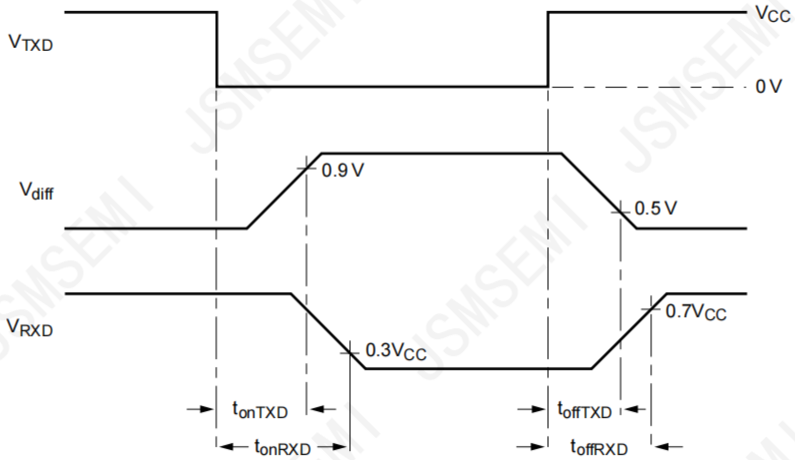


Figure 2. Timing diagram for dynamic characteristics.

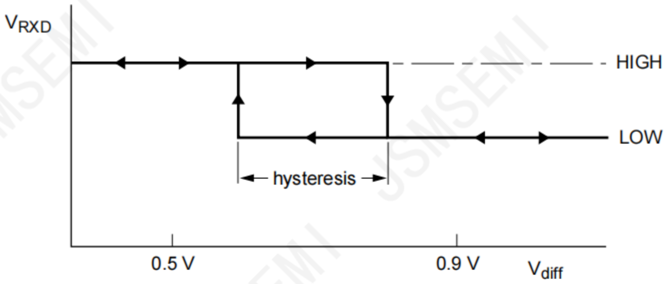
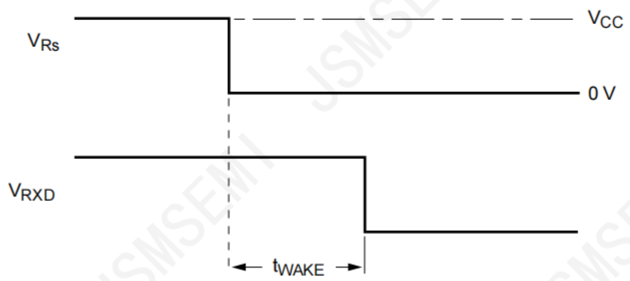
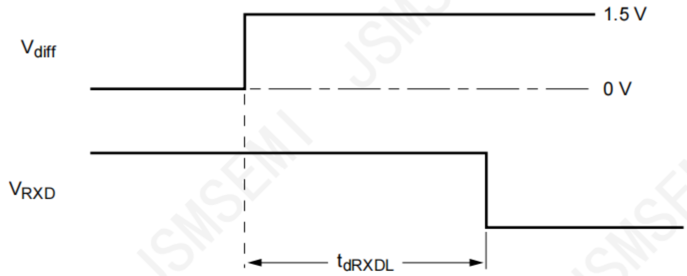


Figure 3. Hysteresis.



V_1 = 1 V.

Figure 4. Timing diagram for wake-up from Standby.



V_1 = 4 V; V_8 = 4 V.

Figure 5. Timing diagram for bus dominant to RXD LOW.

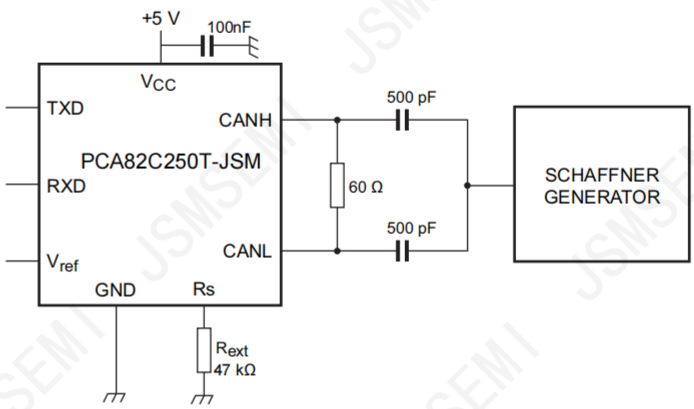


Figure 6. Test circuit for automotive transients.

Application information

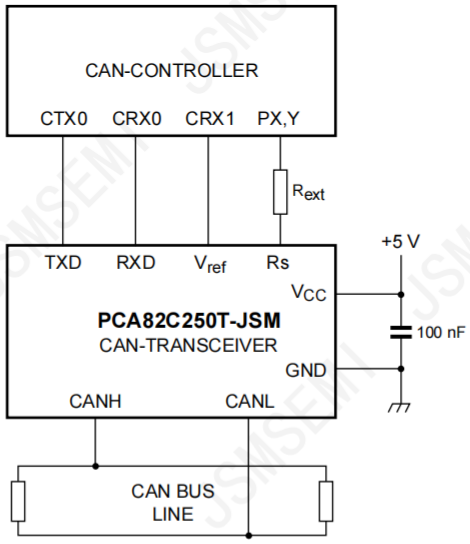


Figure 7.Application of the CAN transceiver.

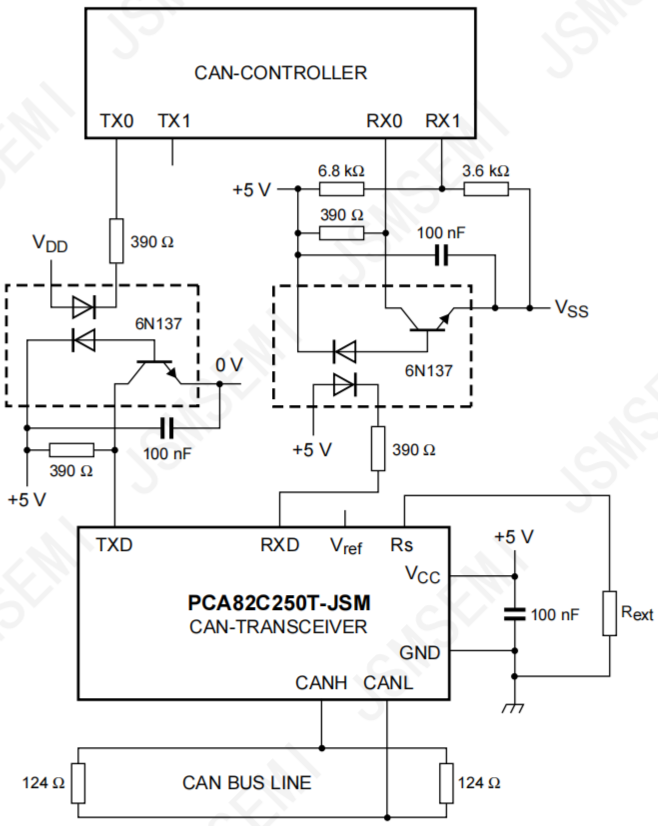
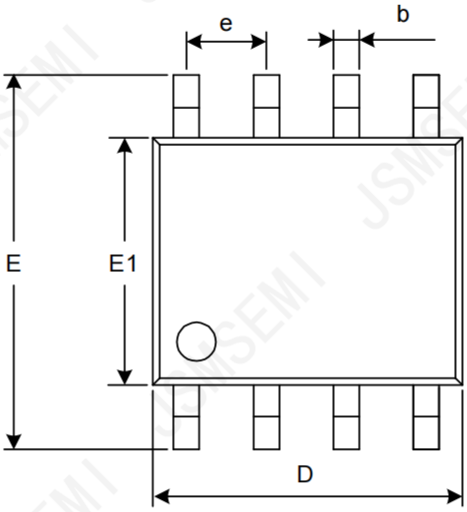
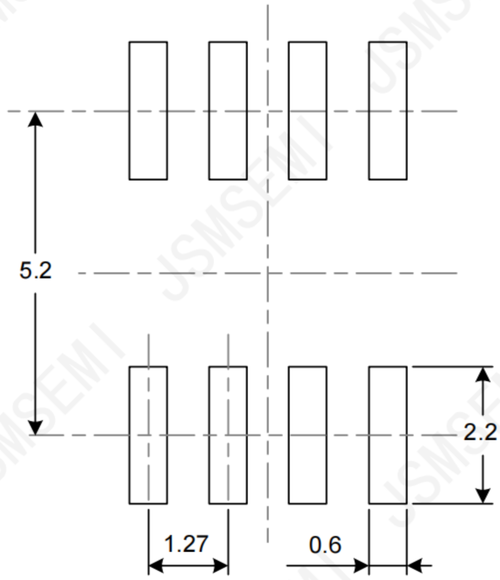


Figure 8.Application with galvanic isolation.

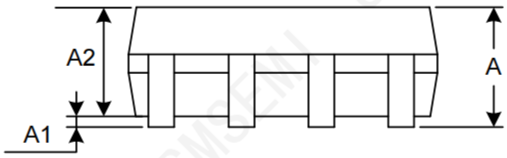
Package Information

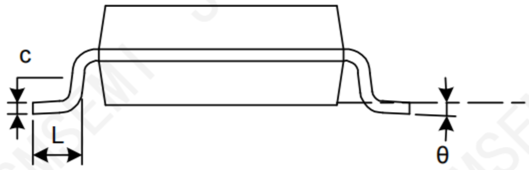
SOIC-8





RECOMMENDED LAND PATTERN (Unit: mm)





Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.007	0.010
D	4.800	5.000	0.189	0.197
e	1.270 (BSC)		0.050 (BSC)	
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

Revision History

Rev.	Change	Date
V1.0	Initial version	3/22/2021

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