

## 24 SERIES

### 3.5A HIGH CURRENT ▲ Si MOSFET RELAY

**SILICON Si MOSFET RELAY** ▲ DIP and SMD type

Up to 3500mA ▲ Switches AC or DC load

One channel and two channel packages available

Input TTL / CMOS compatible








Moisture Sensitivity Level ▲ MSL 1

 **UL 1577 approved** ▲ File no E344988


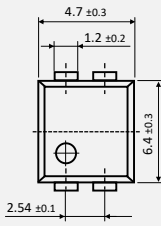
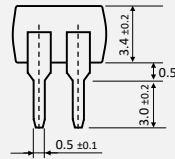
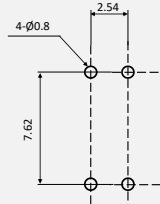
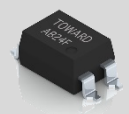
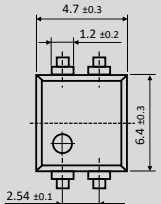
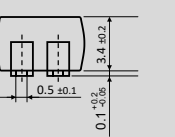
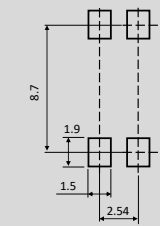
## SPECIFICATION

Item		Characteristics
Contact Form		1 Form A / 2 Form A ▲ Normally open switch
Load Voltage	$V_L$	40V
Operation LED Current	$I_{F\ ON}$	3mA
Load Current	$I_L$	3500mA
On-Resistance	$R_{ON}$	0.027Ω
Output Capacitance	$C_{OUT}$	810pF
Low Off-State Leakage Current	$I_{LEAK}$	1μA at 40V <sub>DC</sub>

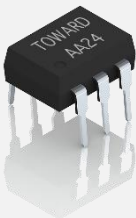
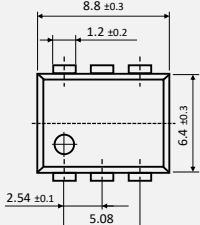
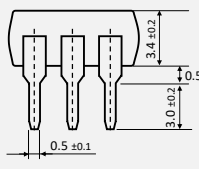
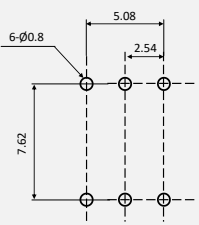

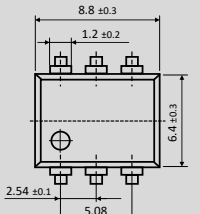
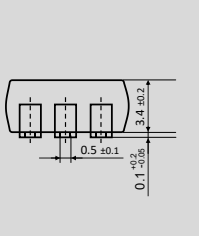
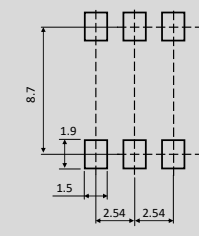
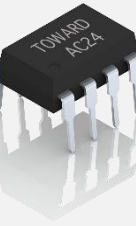
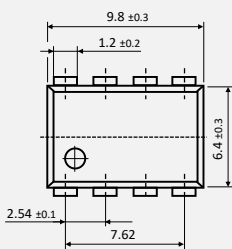
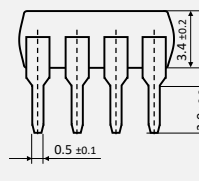
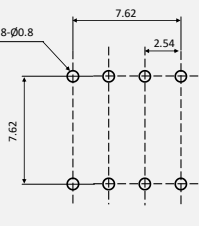

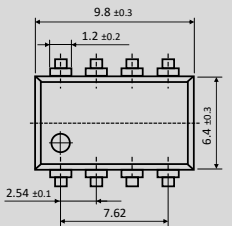
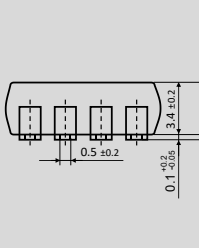
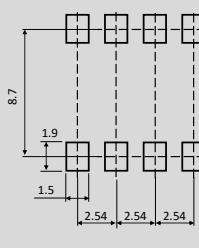

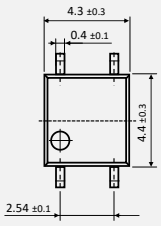
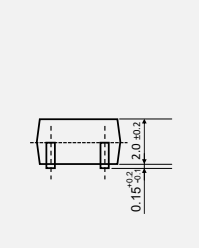
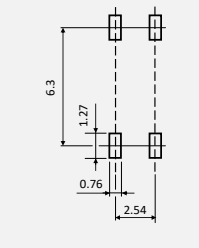

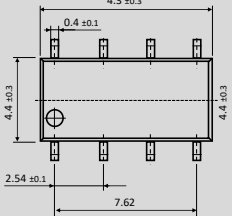
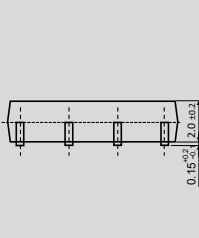
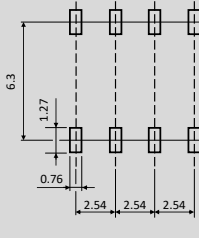
## APPLICATIONS

Automatic Test Equipment	I/O Modules	Industrial Automation	Measurement Equipment	Security Equipment	Sensing Equipment	Telecom Equipment
						

## DIMENSIONS

Package	Illustration	Dimensions		PCB Board Pattern
DIP-4				
SMD-4				

## DIMENSIONS

Package	Illustration	Dimensions		PCB Board Pattern
DIP-6				
SMD-6				
DIP-8				
SMD-8				
SOP-4				
SOP-8				

## ABSOLUTE MAXIMUM RATINGS ▲ AMBIENT TEMPERATURE $T_A = 25^\circ\text{C}$

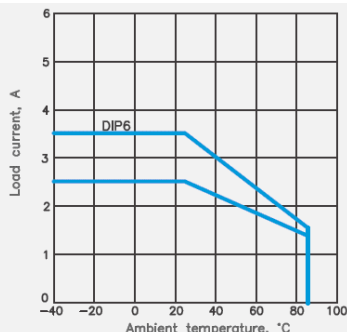
Item	Condition	Symbol	Value					Unit
Type	Outline package		SOP-4	SOP-8	DIP-4 SMD-4	DIP-8 SMD-8	DIP-6 SMD-6	
	Part number		AB24S	AC24S	AB24(F)	AC24(F)	AA24(F)	
	Output channels		1	2	1	2	1	Channels
Input	Continuous LED Current		50					mA
	Peak LED Current	100 Hz, Duty 1%	500					mA
	LED Reverse Voltage		5					V
	Input Power Dissipation		75					mW
Output	Load Voltage		40 (AC peak or DC)					V
	Load Current		2500	2000	2500	2000	3500	mA
	Peak Load Current	1 ms, 1 shot	6000	6000	6000	6000	8000	mA
	Output Power Dissipation		350	450	350	450	500	mW
Relay	Total Power Dissipation		400	500	400	500	550	mW
	I/O Breakdown Voltage		1500	1500	3750	3750	3750	$V_{\text{RMS}}$
	I/O Breakdown Voltage (Suffix-H)		3750	3750	5000	5000	5000	$V_{\text{RMS}}$
	Operating Temperature Range		-40 to +85					$^\circ\text{C}$
	Storage Temperature Range		-40 to +100					$^\circ\text{C}$

## ELECTRICAL CHARACTERISTICS ▲ AMBIENT TEMPERATURE $T_A = 25^\circ\text{C}$

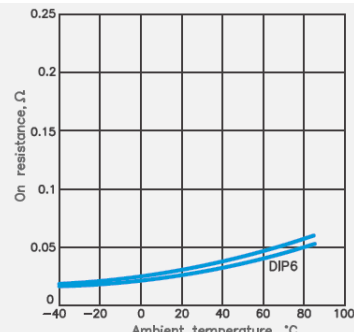
Item	Condition	Symbol	Min.	Typ.	Max.	Unit
Input	LED Forward Voltage	$I_F = 10\text{mA}$	1	1.37	1.5	V
	Operation LED Current			0.5 (SOP) 1.2 (DIP)	3	mA
	Recovery LED Voltage		0.5	1.2		V
Output	On-Resistance	$I_F=5\text{mA}, I_L=\text{Rating}$		0.033	0.043	$\Omega$
	Drain to Drain (tested within 1 sec.)			0.027 (DIP6)	0.035 (DIP6)	
	Off-State Leakage Current	$V_L = 40\text{V}$			1	$\mu\text{A}$
	Output Capacitance	$V_L=0\text{V}, f=1\text{MHz}$		240 810 (DIP6)		pF
Trans- mission	Turn-On Time (for SOP4,8 type)	$I_F=5\text{mA}, I_L=\text{Rating}$		0.8	3	ms
	Turn-On Time (for DIP4,8 type)			1.2		
	Turn-Off Time (for SOP/DIP4,8 type)	$I_F=5\text{mA}, I_L=\text{Rating}$		0.05	0.5	ms
	Turn-On Time (for DIP6 type)	$I_F=10\text{mA}, I_L=\text{Rating}$		1.2	3	ms
	Turn-Off Time (for DIP6 type)	$I_F=10\text{mA}, I_L=\text{Rating}$		0.05	0.5	ms
Coupled	I/O Insulation Resistance			$10^9$		$\Omega$
	I/O Capacitance	$f=1\text{MHz}$		1.3		pF

## REFERENCE DATA

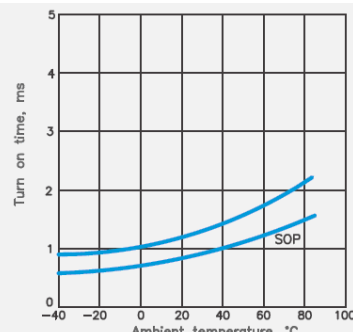
Load current vs. ambient temp.



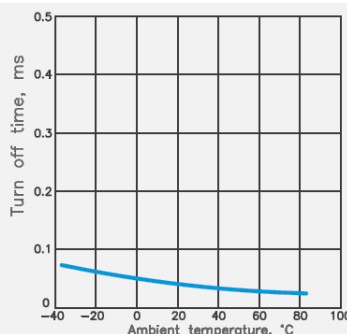
On resistance vs. ambient temp.



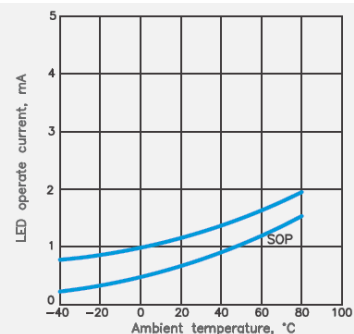
Turn on time vs. ambient temp.



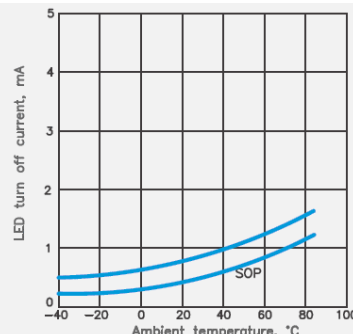
Turn off time vs. ambient temp.



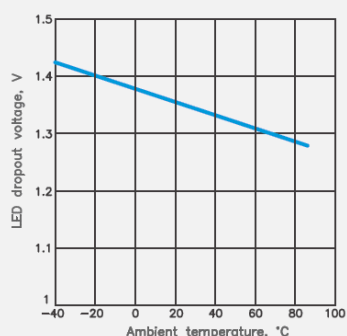
LED operate current vs. ambient temp



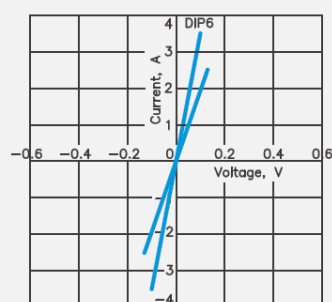
LED turn off current vs. ambient temp.



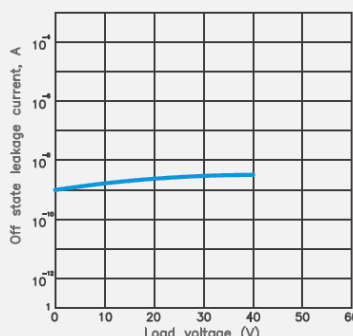
LED forward voltage vs. ambient temp.



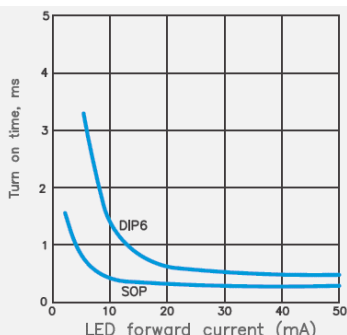
Current vs. voltage characteristics of output at MOS portion



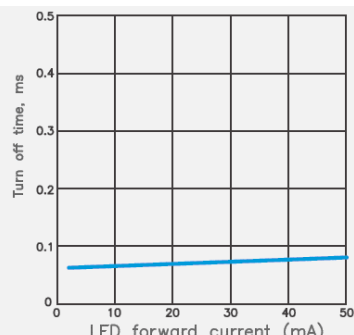
Off state leakage current vs. load voltage



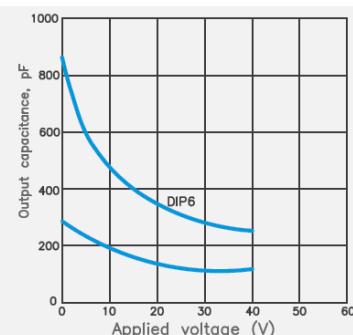
Turn on time vs. LED forward current



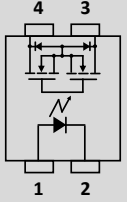
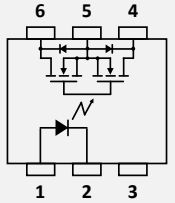
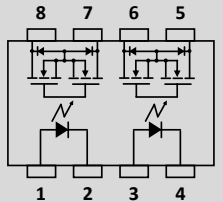
Turn off time vs. LED forward current



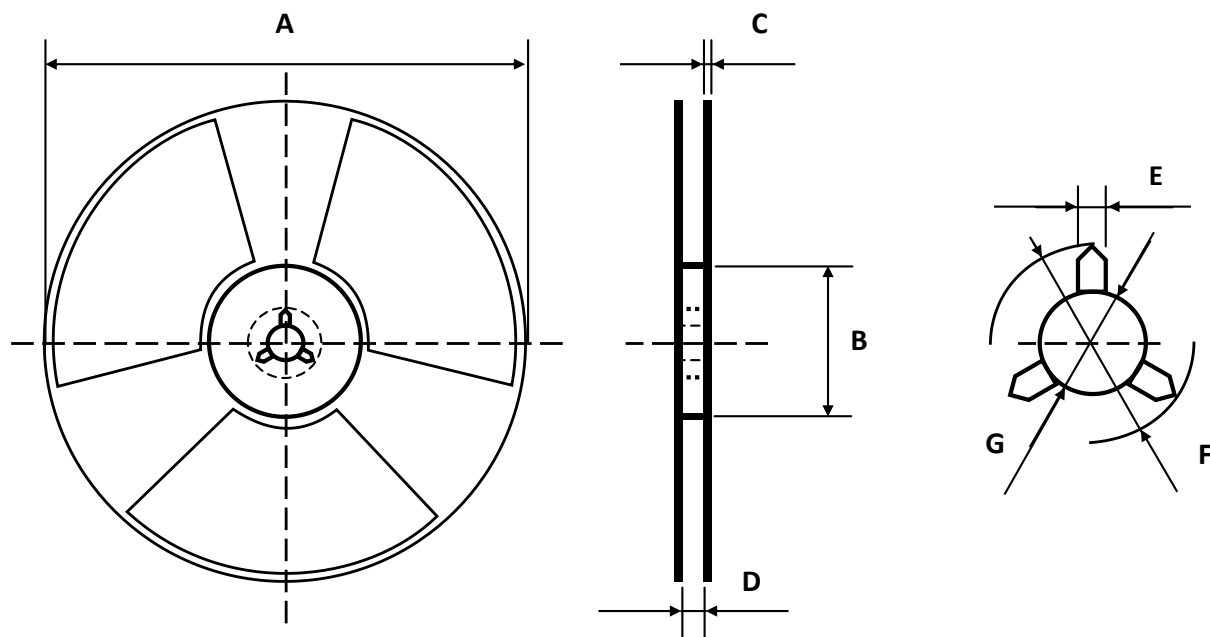
Output capacitance vs. applied voltage



## PIN DESCRIPTION AND PART NUMBER

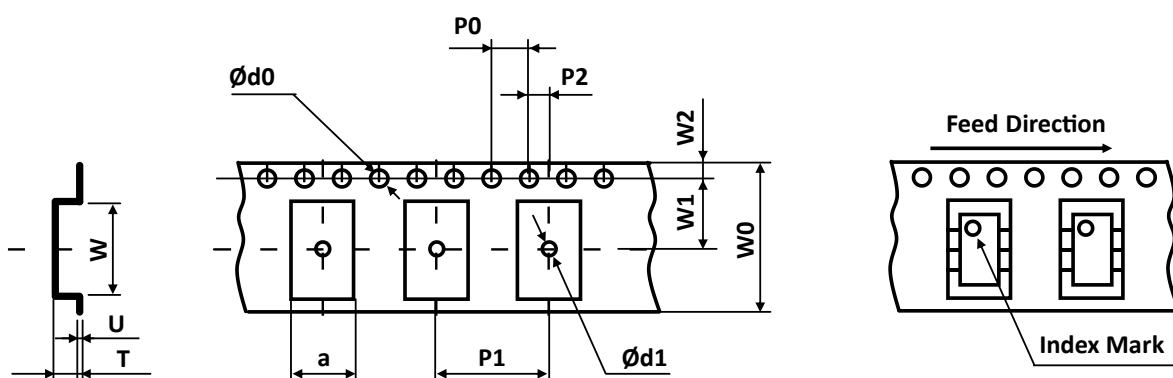
Circuit Diagram	Pin Description		Part No.	Package	Packing
	1	Anode (+) ■ LED	AB24	DIP-4	Tube (90pcs)
	2	Cathode (-) ■ LED	AB24F	SMD-4	Tube (90pcs)
	3,4	Drain ■ MOSFET	AB24S	SOP-4	Tube (100pcs)
			AB24F-R1	SMD-4	Reel (1 000pcs)
			AB24S-R1	SOP-4	Reel (1 000pcs)
	1	Anode (+) ■ LED	AA24	DIP-6	Tube (50pcs)
	2	Cathode (-) ■ LED	AA24F	SMD-6	Tube (50pcs)
	3	NC	AA24F-R1	SMD-6	Reel (1 000pcs)
	4,6	Drain ■ MOSFET			
	5	Source ■ MOSFET			
	1,3	Anode (+) ■ LED	AC24	DIP-8	Tube (45pcs)
	2,4	Cathode (-) ■ LED	AC24F	SMD-8	Tube (45pcs)
	5,6,7,8	Drain ■ MOSFET	AC24S	SOP-8	Tube (50pcs)
			AC24F-R1	SMD-8	Reel (1 000pcs)
			AC24S-R1	SOP-8	Reel (1 000pcs)

## REEL DIMENSIONS ▲ All dimensions in mm



Size	A	B	C	D	E	F	G
SOP-4	330	100	2	13	2	13	21
SOP-8	330	100	2	17	2	13	21
SMD-4	380	80	2.2	17	2	13	21
SMD-6	380	80	2.2	17	2	13	21
SMD-8	380	80	2.2	17	2	13	21

## TAPE DIMENSIONS ▲ All dimensions in mm



Size	W	U	T	a	Ød0	Ød1	P0	P1	P2	W0	W1	W2
SOP-4	4.6	0.3	2.3	7.2	1.5	1.5	4	12	2	12	7.5	1.75
SOP-8	10.4	0.3	2.3	7.5	1.5	1.5	4	12	2	16	7.5	1.75
SMD-4	5.3	0.3	4	10.6	1.5	1.5	4	16	2	16	7.5	1.75
SMD-6	9.15	0.3	4.45	10.4	1.5	1.5	4	16	2	16	11.5	1.75
SMD-8	9.9	0.3	4	10.6	1.5	1.5	4	16	2	16	7.5	1.75

## PACKING QUANTITIES

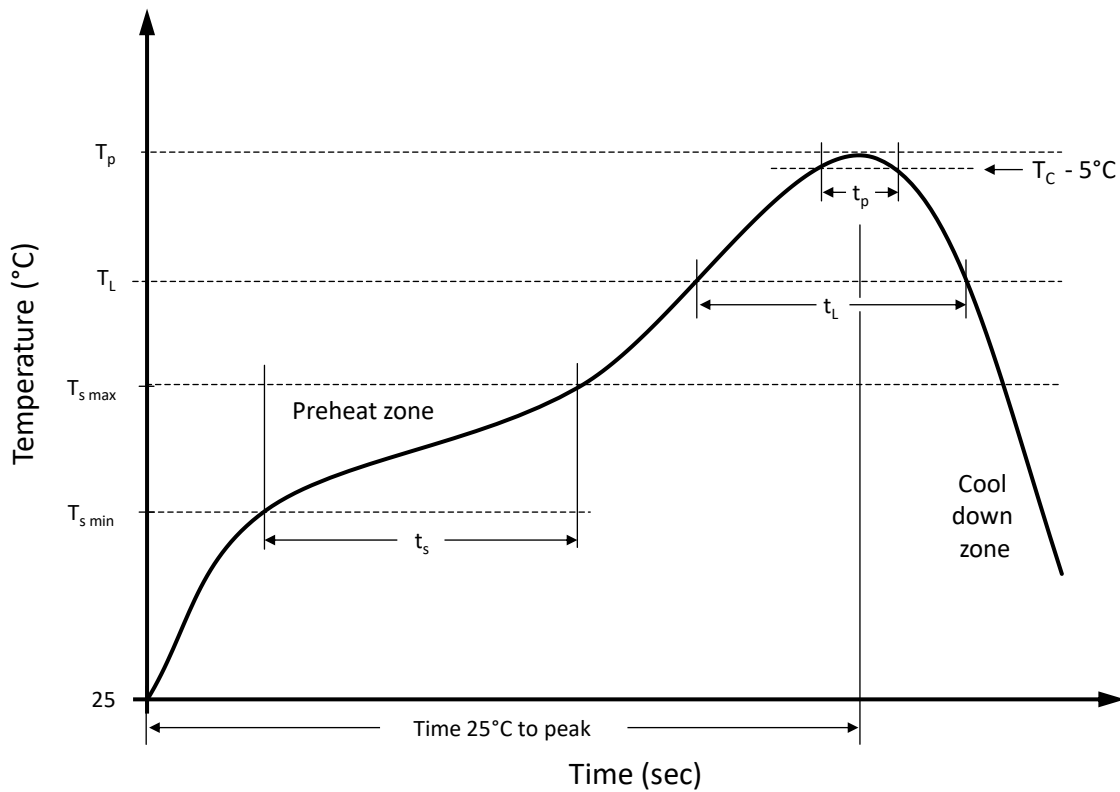
Tape and Reel Packing	PCS/Reel
SMD-4	1 000
SMD-6	1 000
SMD-8	1 000
SOP-4	1 000
SOP-8	1 000

Tube Packing	PCS/Tube	Tubes/Box	Units/Box
DIP-4	90	30	2 700
DIP-6	50	30	1 500
DIP-8	45	30	1 350
SMD-4	90	30	2 700
SMD-6	50	30	1 500
SMD-8	45	30	1 350
SOP-4	100	30	3 000
SOP-8	50	30	1 500

## STORAGE AND HANDLING CONDITIONS

ESD level	Floor life	Conditions	MSL
HBM class 2	Unlimited	T <sub>A</sub> < 30°C, RH < 85%	1

## RECOMMENDED REFLOW SOLDERING PROFILE ▲ SMD PACKAGE

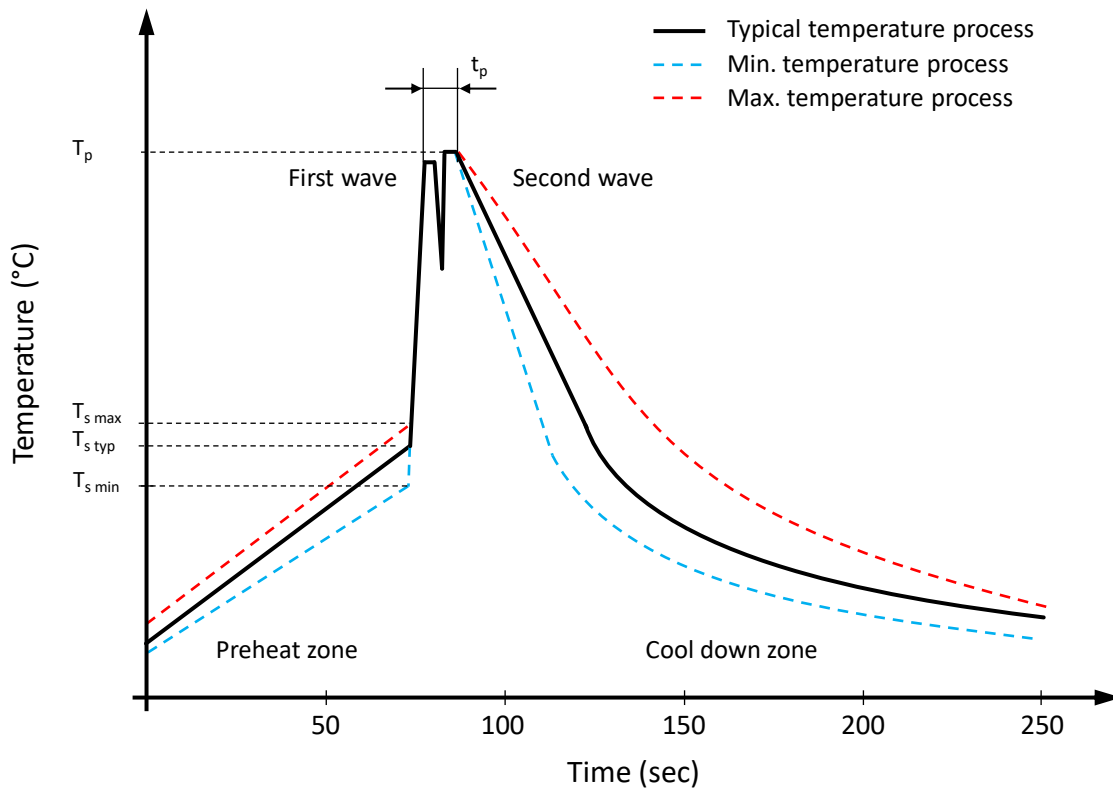


### Recommended reflow soldering conditions ▲ Refer to JEDEC J-STD-020E

Profile Features		Sn-Pb Eutetic Assembly	Pb-Free Assembly
Preheat temperature min.	$T_{s \min}$	100 °C	150 °C
Preheat temperature max.	$T_{s \max}$	150 °C	200 °C
Preheat time $t_s$ from $T_{s \min}$ to $T_{s \max}$	$t_s$	120 seconds	120 seconds
Ramp-up rate ( $T_L$ to $T_p$ )		max. 3 °C/second	max. 3 °C/second
Liquidous temperature	$T_L$	183 °C	217 °C
Time $t_L$ maintained above $T_L$	$t_L$	150 seconds max.	60 seconds max.
Peak package body temperature	$T_p$	235°C	260°C
Timeframe of within 5°C below and up to max actual peak body temperature	$t_p$	20 seconds max.	30 seconds max.
Ramp-down rate ( $T_L$ to $T_p$ )		max. 6 °C/second	max. 6 °C/second
Time 25°C to peak temperature		max. 6 minutes	max. 8 minutes



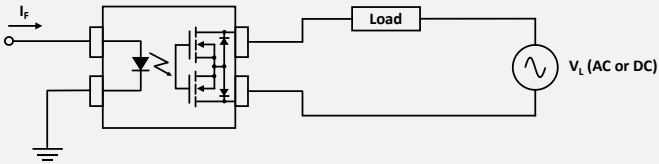
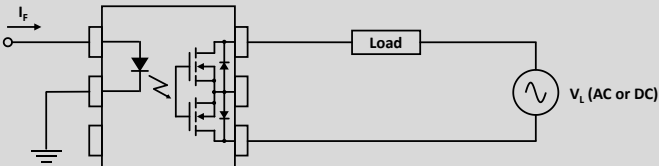
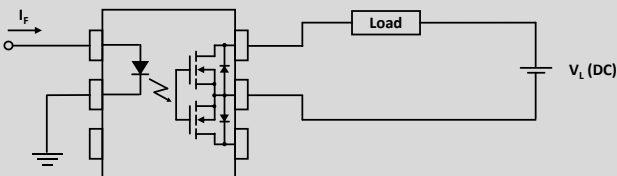
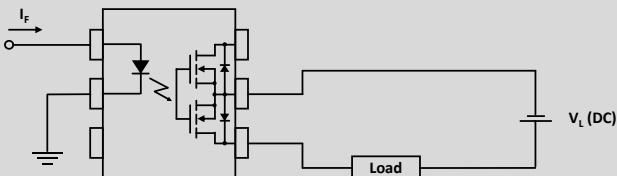
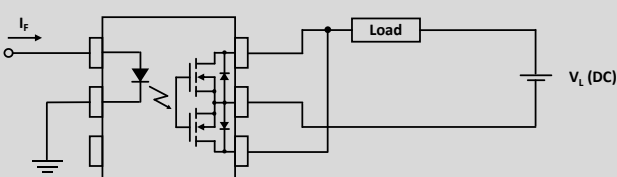
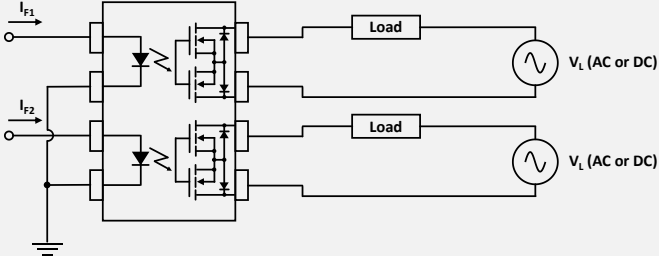
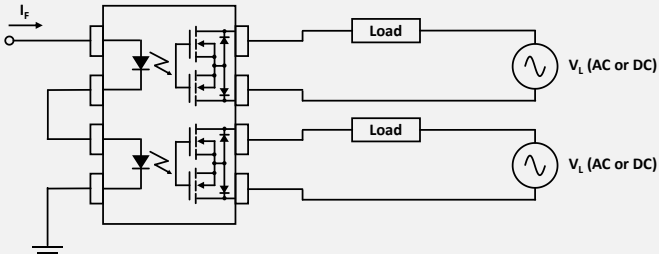
## RECOMMENDED WAVE SOLDERING PROFILE ▲ THT PACKAGE



### Classification wave soldering profile ▲ Refer to EN 61760-1: 2006

Profile Features		Value ▲ Sn-Pb Assembly	Value ▲ Pb-free Assembly
Preheat temperature min.	$T_{s \min}$	100 °C	100 °C
Preheat temperature typical	$T_{s \text{ typ}}$	120 °C	120 °C
Preheat temperature max.	$T_{s \max}$	130 °C	130 °C
Preheat time $t_s$ from $T_{s \min}$ to $T_{s \max}$	$t_s$	70 seconds	70 seconds
Peak temperature	$T_p$	235 °C to 260 °C	245 °C to 260 °C
Time of actual peak temperature	$t_p$	Max. 10 seconds Max. 5 second each wave	Max. 10 seconds Max. 5 second each wave
Ramp-down rate min.		~ 2 °C/second	~ 2 °C/second
Ramp-down rate typical		~ 3.5 °C/second	~ 3.5 °C/second
Ramp-down rate max.		~ 5 °C/second	~ 5 °C/second
Time 25°C to 25°C		4 minutes	4 minutes

## LOAD CONNECTING METHOD

Type	Load		Connection	Feature
4 pins	AC or DC			Control bi-directional signal
6 pins	A	AC or DC		Control bi-directional signal
	B	DC		On-resistance is 1/2 of A-connection 2-Make-contacts (Source Common)
				
	C	DC		On-Resistance is 1/2 of B-connection
8 pins	AC or DC			2 input and 2 output
				1 input and 2 output

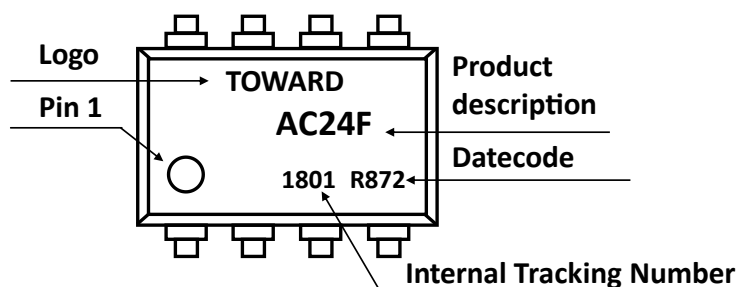
## PRODUCT CODE

Example: AC24F series ▲ 2 Form A ▲ 40V ▲ SMD-8 ▲ Tape & Reel

AC		24		-		F		R1	
Package		Series		Special Suffix		Type		Packing	
AA	6 Pin ▲ 1 Form A	24	40V	Blank H	Standard High Insulation	Blank F S	DIP SMD SOP	Blank R1	Tube Reel
AB	4 Pin ▲ 1 Form A								
AC	8 Pin ▲ 2 Form A								

## PRODUCT MARKING

Example: AC24F series ▲ 2 Form A ▲ 40V ▲ SMD-8 ▲ Tape & Reel



## DATE CODE

Example: R872

R		8		7		2	
Material Characteristics		Year		Month		Week of the Month	
R	RoHS compliant	8	2018	1	Jan	1 2 3 4	1 <sup>st</sup>
		9	2019	2	Feb		2 <sup>nd</sup>
		A	2020	3	Mar		3 <sup>rd</sup>
		B	2021	4	Apr		4 <sup>th</sup>
H	Halogen free	C	2022	5	May		
		...	...	...	...		
		G	2026	12	Dec		

## RELIABILITY TESTS ▲ STANDARD

Standard: JESD22-A

No.	Test	Test Specification	Test Standard	Test Limits
1	Moisture Sensitivity Level Test	Bake condition: Temperature: 125°C; Duration 24 hours Soak condition: Temperature: 30°C; Humidity: 60% RH Duration 192 hours Reflow condition: Peak temperature: 260°C Duration: 3 cycles	JESD22-A113H	No abnormal phenomenon was found. Functional test passed.
2	High Temperature Storage Test	Temperature: 150°C Duration: 500 hours	JESD22-A103E	No abnormal phenomenon was found. Functional test passed.
3	Temperature Cycling Test	Temperature range: -55°C to +125°C -55°C for 30 minutes +125°C for 30 minutes Duration: 100 cycles with 1 cycle = 70 minutes	JESD22-A104E	No abnormal phenomenon was found. Functional test passed.
4	Low Temperature Storage Test	Temperature: -40°C Duration: 500 hours	JESD22-A119E	No abnormal phenomenon was found. Functional test passed.
5	Temperature & Humidity Storage Test	Temperature: 85°C Humidity: 85% RH Duration: 500 hours	JESD22-A101D	No abnormal phenomenon was found. Functional test passed.
6	Highly Accelerated Temperature and Humidity Stress Test	Temperature: 130°C Humidity: 85% RH Duration: 96 hours	JESD22-A-118B	No abnormal phenomenon was found. Functional test passed.

## REVISION TABLE

Revision	Date	Status	Notes
001	01/10/2021	Initial release	Initial publication

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