SIEMENS

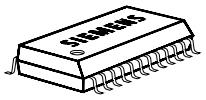
Intelligent Sixfold Low-Side Switch

TLE 4216 G

Bipolar IC

Features

- Double low-side switch, 2 x 0.5 A
- Quad low-side switch, 4 x 50 mA
- Power limitation
- Open-collector outputs
- Overtemperature shutdown
- Status monitoring
- Shorted-load protection
- Integrated clamp Z-Diodes
- Temperature range – 40 to 110 °C



P-DSO-24-3

Type	Ordering Code	Package
TLE 4216 G	Q67000-A9108	P-DSO-24-3 (SMD)

TLE 4216 G is an integrated, sixfold low-side power switch with power limiting of the 0.5 A outputs, shorted load protection of the 50 mA switches and Z-diodes on all switches from output to ground. TLE 4216 G is particularly suitable for automotive and industrial applications.

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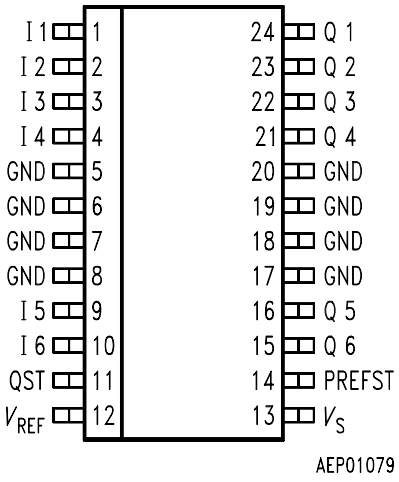
Pin Configuration
(top view)

TLE 4216 G



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Pin Definitions and Functions

TLE 4216 G	Symbol	Function
Pin No.		
1, 2, 3, 4	I1, I2, I3, I4	Inputs of 50-mA switches 1, 2, 3, 4
5, 6, 7, 8	GND	Ground, cooling
9, 10	I5, I6	Inputs of 0.5 A switches 5, 6
11	Q_{ST}	Status analog output
12	V_{REF}	Reference voltage; a higher reference voltage than the internal one can be applied from the exterior as a voltage reference for the status output (A/D converter).
13	V_S	Supply voltage
14	PREFST	Preferred state (low = preferred state of all outputs regardless of inputs)
15, 16	Q6, Q5	Outputs 6, 5 (0.5 A), open collector
17, 18, 19, 20	GND	Ground, cooling
21, 22, 23, 24	Q4, Q3, Q2, Q1	Outputs 4, 3, 2, 1 (50 mA), open collector

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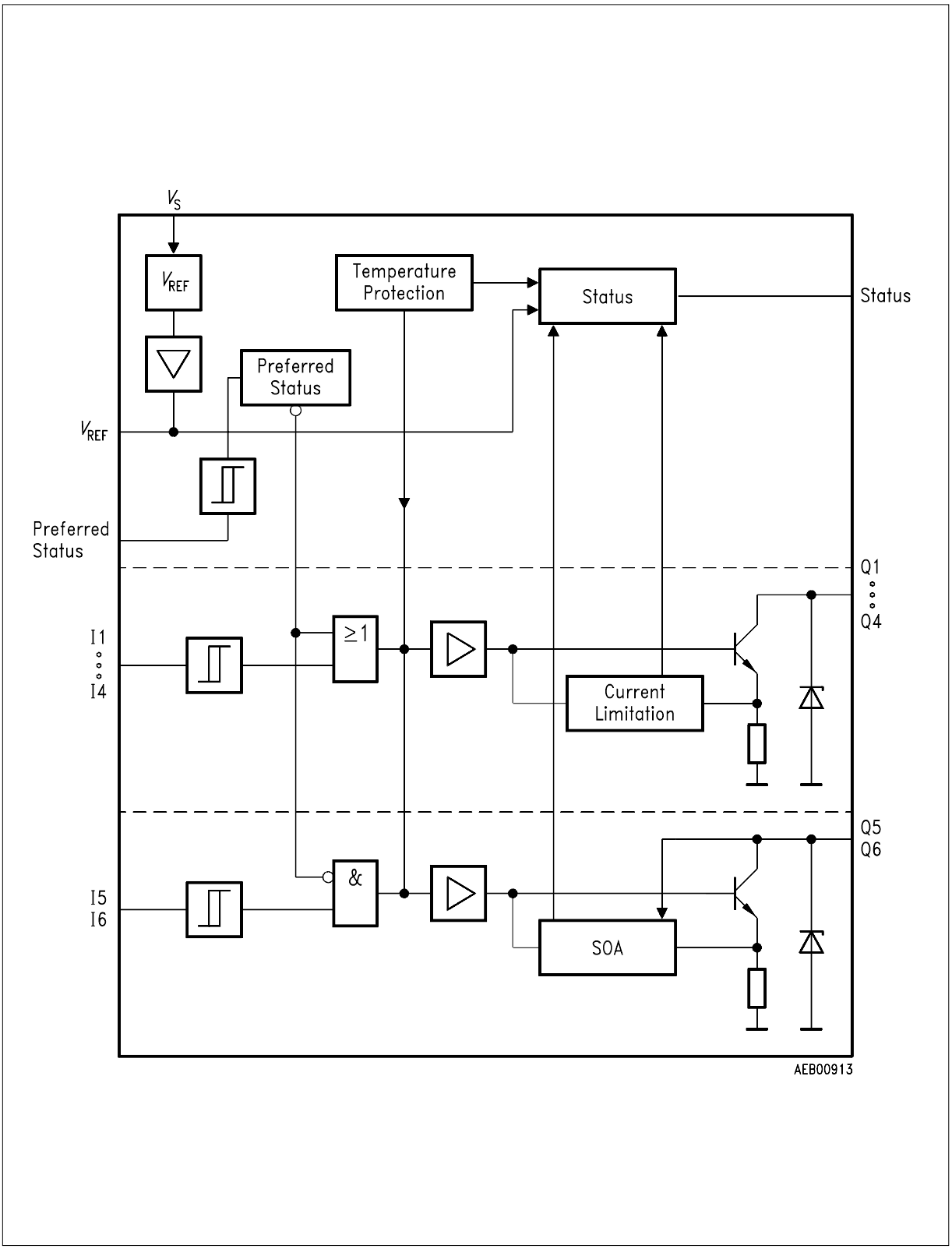

Block Diagram

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Circuit Description

Input Circuits

The control inputs and the preferred-state input consist of TTL-compatible Schmitt triggers with hysteresis. Driven by these stages the buffer amplifiers convert the logic signal necessary for driving the NPN power transistors.

Switching Stages

The output stages consist of NPN power transistors with open collectors. Each stage has its own protective circuit for limiting power dissipation and shorted-load current, which makes the outputs shorted-load protected to the supply voltage throughout the operating range. Integrated Z-diodes limit positive voltage spikes that occur when inductive loads are discharged.

Monitoring and Protective Functions

Each output is monitored in its activated status for overload. Furthermore, large parts of the circuitry are shutdown (control, output stages). The information from these malfunctions is ORed and applied to the status output. If several malfunctions appear simultaneously, the highest voltage level will dominate. The IC is also protected against thermal overload. If a chip temperature of typically 160 °C is reached, overtemperature is signalled on the status output. If the temperature continues to increase, all outputs are turned off at 170 °C.

If the minimum supply voltage for functioning is not maintained, the output stages become inactive. At a supply voltage of 2 to 4 V, the outputs are switched to a preferred state regardless of the level on pin PREFST. If the preferred state is to be maintained beyond this range, pin PREFST must be switched to low potential. Above a supply voltage of typical 3 V (max. 4 V) the preferred state is controlled by pin PREFST. From 4 to 5.2 V the logic operation of the outputs is guaranteed, but the status output cannot be evaluated. At a supply voltage of 5.2 to 30 V the full function is guaranteed.

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Application Description

Applications in automotive electronics require intelligent power switches activated by logic signals, which are shorted-load protected and provide error feedback.

The IC contains six power switches connected to ground (low-side switch). On inductive loads the integrated Z-diodes clamp the discharging voltage.

By means of TTL signals on the control inputs (active high) all six switches can be activated independently of another when a high level appears on the preferred-state input. When there is a low level on the preferred-state input, switches 1 to 4 are switched on, switches 5 and 6 are switched off regardless of the input level. The inputs are highly resistive and therefore must not be left unconnected, but should always be on fixed potential (noise immunity).

The status output signals the following malfunctions by analog voltage levels:

- Overload
- Overtemperature

Possible Input and Output Levels

Supply Voltage V_S	PREFST	I1 … I6	Q1 … Q4	Q5, Q6
2 to 4 V	L	X	L	H
4 to 30 V	H	L	H	H
4 to 30 V	H	H	L	L

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Absolute Maximum Ratings

T_j = – 40 to 150 °C

Parameter	Symbol	Limit Values		Unit	Remarks
		min.	max.		
Voltages					
Supply voltage	V_S	– 1	40	V	
Supply voltage, load circuit	V_{Q1-6}	– 0.7	25	V	
Input voltage	V_{I1-6}, V_{PREFST}	0	V_S	V	
Input voltage	$V_{REF\ ext}$	– 0.7	7	V	
Currents					
Switching current	I_{Q1}-I_{Q6}				limited internally
Current on reverse poling in load circuit	$I_{Q5, Q6}$	– 0.5		A	
Current on reverse poling in load circuit	I_{Q1-Q4}	– 50		mA	
Output current positive clamp	I_{Z5-Z6}		0.7	A	
Output current positive clamp	I_{Z1-Z4}		70	mA	
Junction temperature	T_j	– 40	150	°C	Thermal overload shutdown at 170 °C
Storage temperature	T_{stg}	– 50	150	°C	

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Operating Range

Parameter	Symbol	Limit Values		Unit	Remarks
		min.	max.		
Supply voltage	V_S	5.2	30	V	$V_{REF} \leq V_S$, functioning is guaranteed at V_S = 4 – 5.2 V but status output cannot be evaluated.
Supply voltage in load circuit	$V_{Q1\text{-}6}$	– 0.3	24	V	
Ambient temperature	T_A	– 40	110	°C	
Supply voltage for load short-circuit	V_S		16	V	
Input current (high)	I_{IH}		100	µA	
Thermal resistance Junction-ambient	$R_{th\ JA}$		65	K/W	P-DSO-24-3

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Characteristics

V_S = 5 to 12 V; T_j = – 25 to 140 °C

Parameter	Symbol	Limit Values			Unit	Test Condition
		min.	typ.	max.		
General						
Supply current	I_S		50	70	mA	$V_I > V_{IH}$; $V_{IP} > V_{IH}$
Supply current	I_S		36	50	mA	$V_I > V_{IH}$; $V_{IP} > V_{IH}$; V_S = 5 V
Quiescent current	I_S		8	11	mA	$V_I < V_{IL}$; $V_{IP} > V_{IH}$
Logic (Control inputs + preferred state)						
H-switching threshold	V_{IH}	1.3	1.8	2.1	V	
L-switching threshold	V_{IL}	0.9	1.2	1.5	V	
Hysteresis	ΔV_I	0.3	0.6	1.0	V	
Input current						
Input current	I_I	–2		2	µA	0.9 V < V_I < 6 V
L-input current	$-I_{IL}$	0		20	µA	0.5 V < V_I < 0.9 V
Switching Stages						
Load current	$I_{Q1\text{-}Q4}$	50			mA	V_S = 2 V (preferred state)
Saturation voltage	$V_{QSat\ 5,\ 6}$		0.5	0.8	V	I_Q = 0.4 A; $V_I > V_{IH}$
Saturation voltage	$V_{QSat\ 1\text{-}4}$		0.4	0.6	V	I_Q = 50 mA; $V_I > V_{IH}$
Saturation voltage	$V_{QSat\ 1\text{-}4}$			0.22	V	I_Q = 20 mA; $V_I > V_{IH}$
Turn-ON time	$t_{D\text{-}ON}$	0.2	1	1.5	µs	**see Diagrams**
Turn-OFF time	$t_{D\text{-}OFF}$	0.2	1	1.5	µs	**see Diagrams;** $I_L = I_{max}$

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Characteristics (cont'd)

V_S = 5 to 12 V; T_j = – 25 to 140 °C

Parameter	Symbol	Limit Values			Unit	Test Condition
		min.	typ.	max.		
Temperature Protection						
Overtemperature (signaled on status output)			160		°C	
Overtemperature (outputs shut down)			170		°C	
Outputs						
Output voltage pos. clamp	V_{Q1-4}	25.5		33	V	$I = 50$ mA
Output voltage pos. clamp	V_{Q5-6}	25.5		35	V	$I = 0.5$ A
Shorted-load current	$I_{Q1max-Q4max}$	50		120	mA	V_Q < 16 V
Leakage current	I_{Q1-4}			200	nA	V_Q = 24 V; T_j = 125 °C
Leakage current	$I_{Q5;6}$			300	µA	V_Q = 24 V
Shorted-load current	$I_{Q5max-Q6max}$					**see Diagrams**
Status output						
No error	V_{st}			0.5	V	V_{REF} = 5 V [1]
Overload output 6	V_{st}	1.0		1.3	V	V_{REF} = 5 V [1]
Overload output 5	V_{st}	1.4		1.7	V	V_{REF} = 5 V [1]
Overload output 4	V_{st}	1.8		2.1	V	V_{REF} = 5 V [1]
Overload output 3	V_{st}	2.2		2.5	V	V_{REF} = 5 V [1]
Overload output 2	V_{st}	2.6		2.9	V	V_{REF} = 5 V [1]
Overload output 1	V_{st}	3.0		3.3	V	V_{REF} = 5 V [1]
Overtemperature	V_{st}	3.5			V	V_{REF} = 5 V [1]

[1] The limits shift proportionally for a higher value of reference voltage.

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Characteristics (cont'd)

V_S = 5 to 12 V; T_j = – 25 to 140 °C

Parameter	Symbol	Limit Values			Unit	Test Condition
		min.	typ.	max.		
Source resistance of status output	R_{QSt}	100		550	Ω	
Delay time of status	t_{dst}			10	µs	Shorted load
Reference voltage (internal)	V_{REF}		2.5		V	
Input resistance of reference pin	$R_{REF\ in}$	7	10	14.5	kΩ	V_{REF} = 2.8 V … 6.5 V

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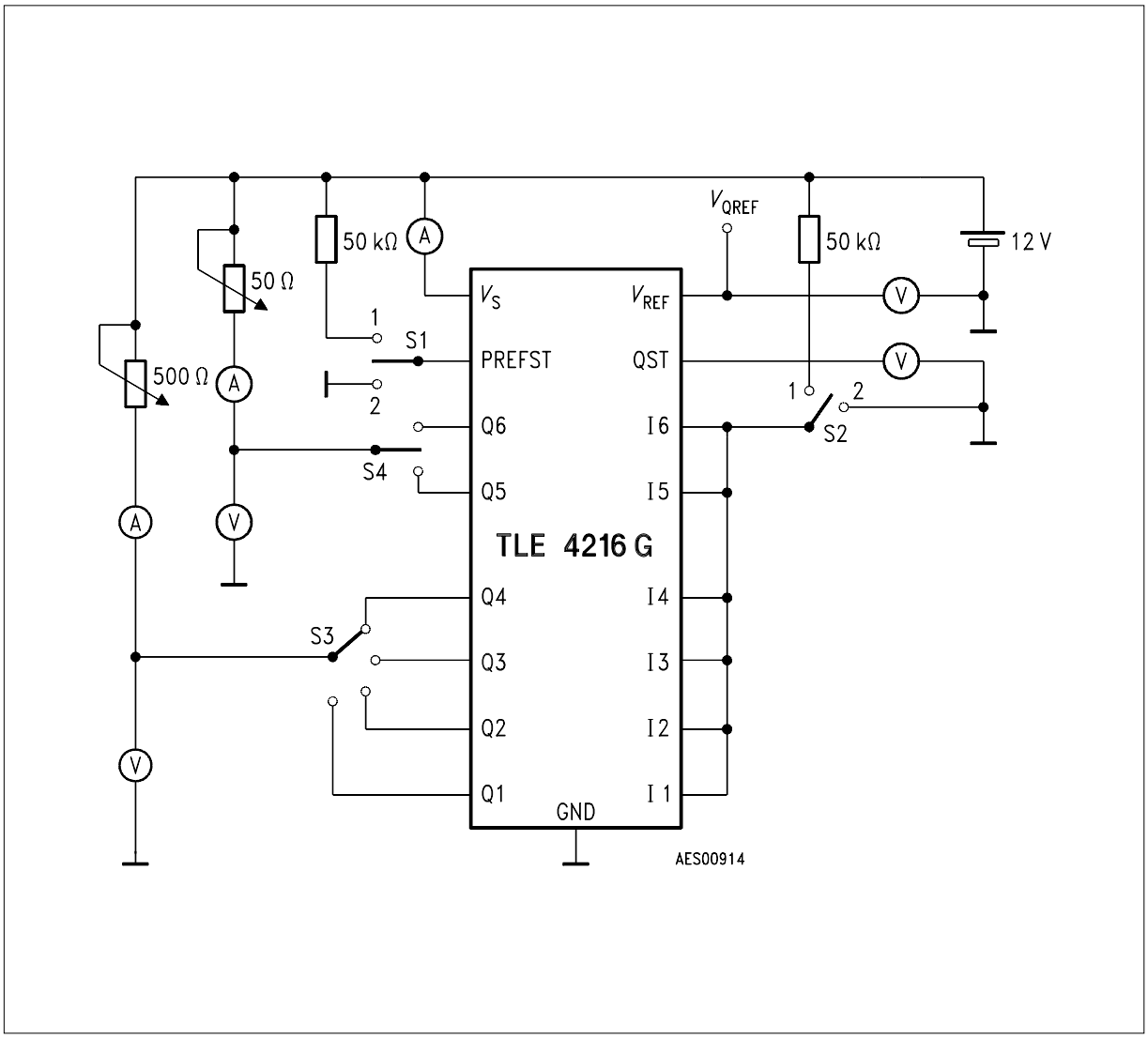

Test Circuit

S1 in position 1: all switches can be activated by S2 (position 1) or deactivated (position 2)

S1 in position 2: preferred state

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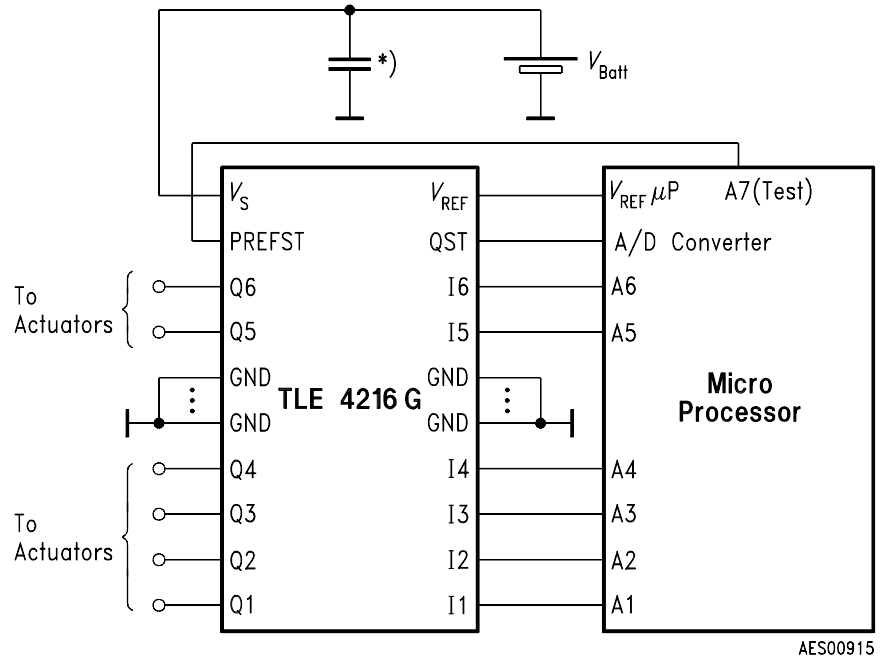

Application Circuit

*) The capacitance depends on the inductance and current load of the supply.

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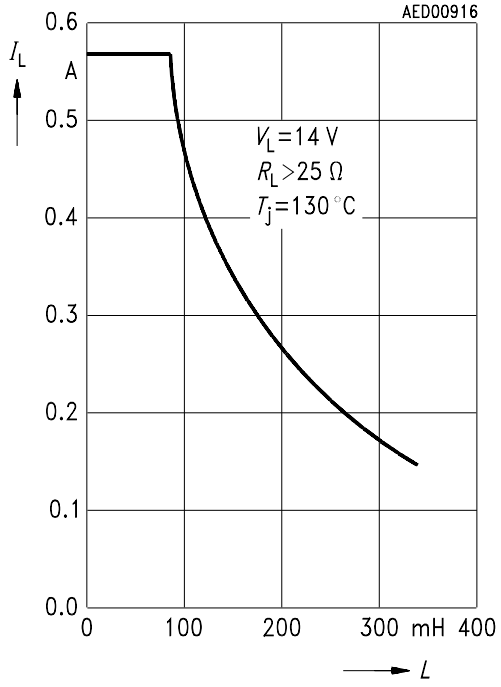
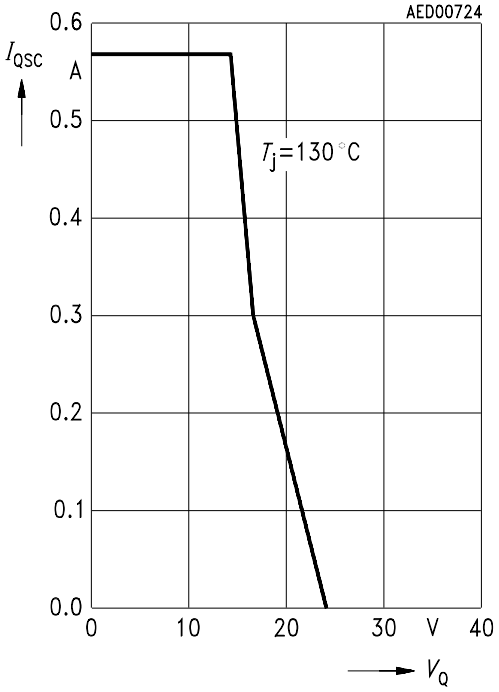
Diagrams

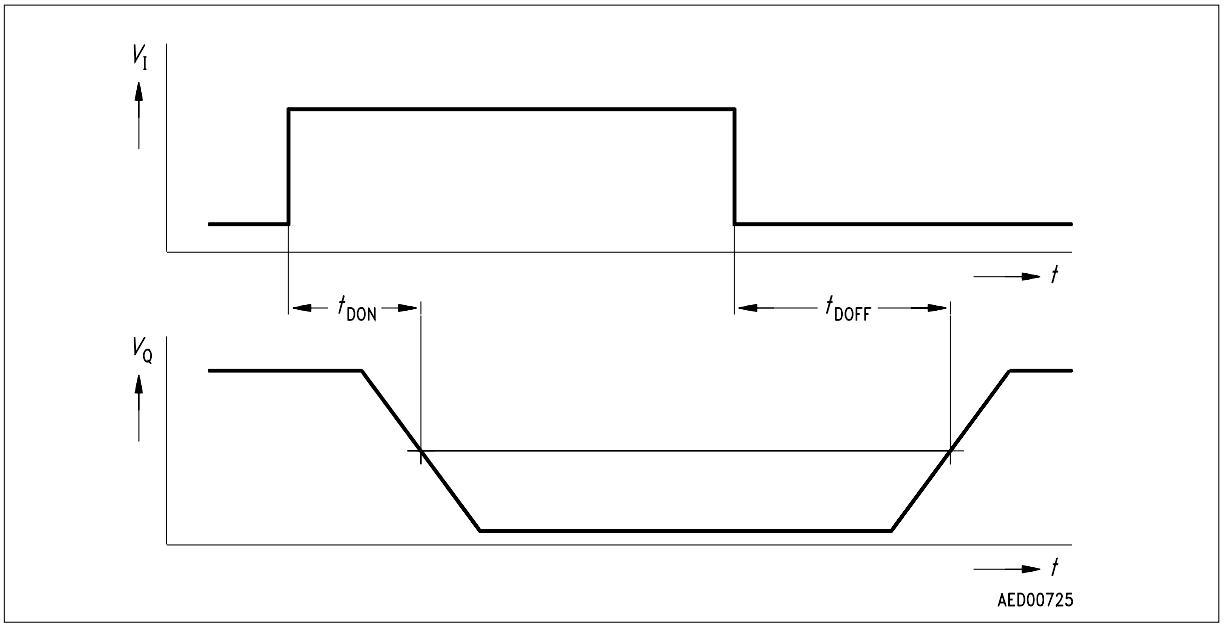
Permissible Load Inductance versus Load Current



Short-Circuit Current I_{QO} versus Output Voltage V_Q (0.5 A outputs)



When switching the maximum inductive loads, the maximum temperature T_j of 150 °C may be briefly exceeded. The IC will not be destroyed by this, but the restrictions concerning useful life should be observed.



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