

MITSUBISHI HYBRID IC
M57161L-01

FOR DRIVING TRENCH-GATE IGBT

DESCRIPTION

M57161L-01 is a hybrid IC designed to drive trench-gate IGBT module with built in RTC.

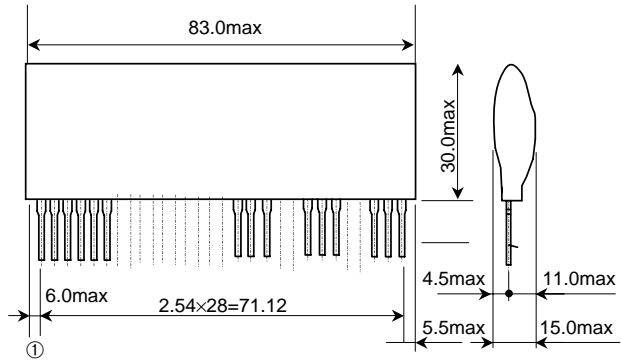
This device can operate by an input of +15V because of electrical isolation between the input and output by an opto coupler, and the built in DC-DC converter isolated between a pair of positive/negative outputs for gate driving.

With built in protection circuits, this device can maintain a reverse bias for a predetermined time after the detection of an over current (short circuit). Therefore, the protective system operates with a margin of time.

The over current (short circuit) detector functions with RTC circuit built in IGBT module to detect a drop of gate voltage.

OUTLINE DRAWING

Dimensions : mm



Recommend module ; IGBT module (F)series

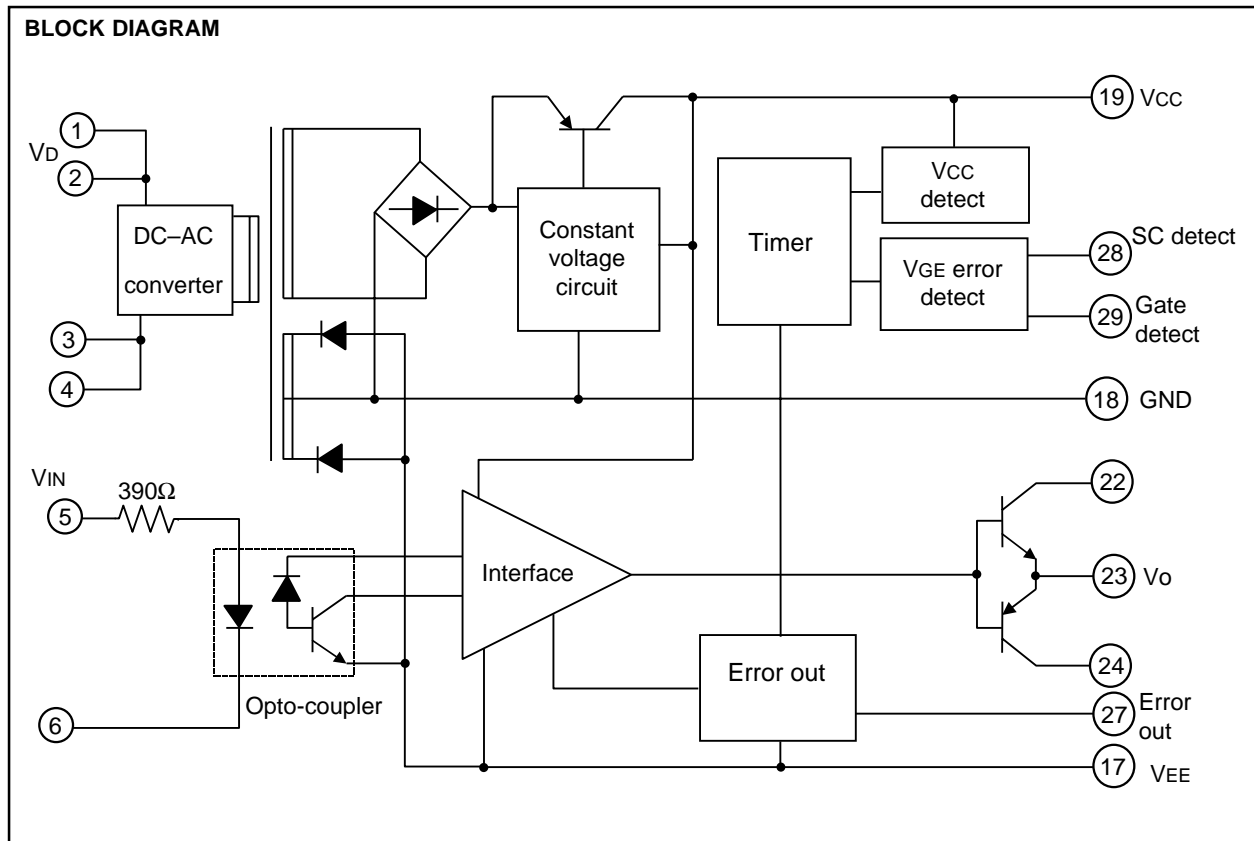
FEATURES

- Built in insulated DC-DC converter for IGBT drive
- Built in short circuit protection circuit
- Electrical isolation between input and output with opto-coupler ($V_{ios}=2500V_{rms}$ for 1minute)

APPLICATION

To drive IGBT module for inverter or AC servo systems application

BLOCK DIAGRAM



M57161L-01

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ABSOLUTE MAXIMUM RATINGS (Unless otherwise specified, Ta = 25°C)

Symbol	Parameter	Conditions	Ratings	Units
V _D	Supply voltage		16	V
V _I	Input voltages	Applied between:⑤-⑥	-1 ~ +7	V
V _O	Output voltages	At the output voltage "H" V _D =15.7V	16.5	V
I _{OHP}	Output current	Pulse width 1μs, f≤20kHz	-7	A
I _{OLP}			7	A
V _{iso}	Isolation voltage	Sine-wave voltage 60Hz, 1min	2500	Vrms
T _c	Case temperature		85	°C
T _{opr}	Operating temperature		-20 ~ +60	°C
T _{stg}	Storage temperature		-25 ~ +100	°C
I _{FO}	Fault output current	Input current 27pin	25	mA
V _R	Applied 29 pin		V _{CC}	V

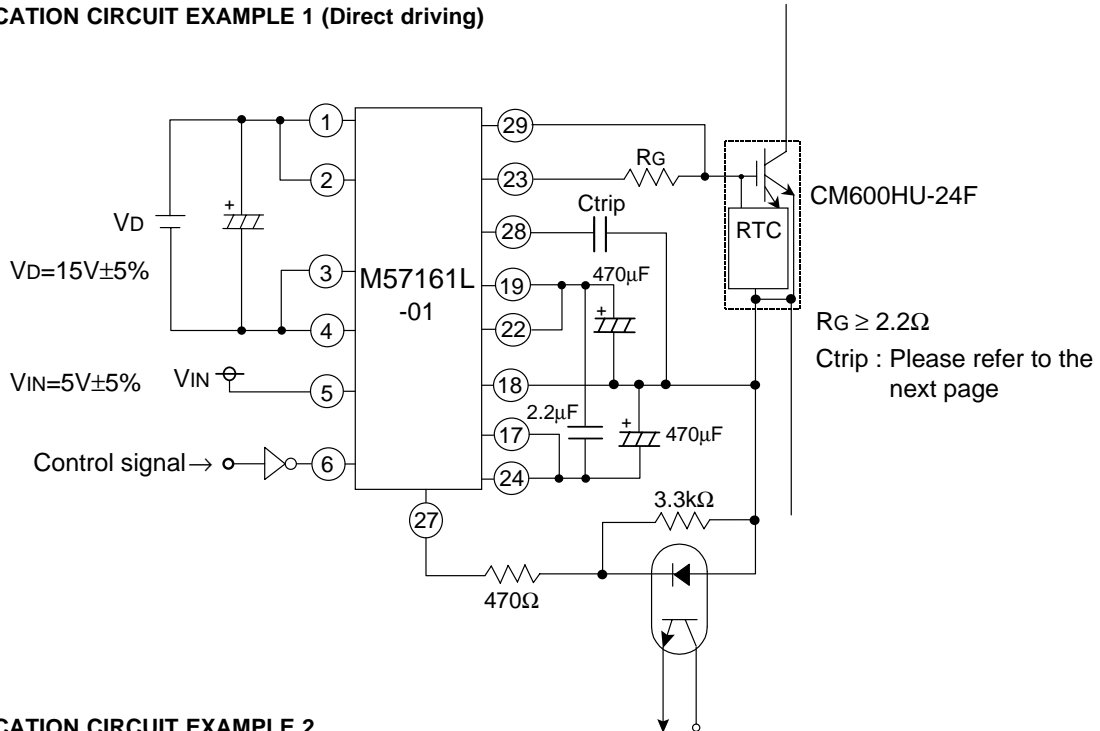
ELECTRICAL CHARACTERISTICS (Ta = 25°C, V_D = 15.0V, V_{IN} = 5.0V, f = 20kHz, R_G = 2.2Ω : CM600HU-24F)

Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
V _D	Supply voltage	Recommended range	14.3	15.0	15.7	V
V _{IN}	Pull-up voltage on input side	Recommended range	4.5	5.0	5.5	V
I _{IH}	"H" Input current	Recommended range	9	10	11	mA
f	Switching frequency	Recommended range	—	—	20	kHz
R _G	Gate resistor	Recommended range	2.2	—	—	Ω
I _{IH}	"H" Input current	V _{IN} =5V	—	10	—	mA
V _{CC}	Gate + supply voltage	V _{IN} =0V, f=0Hz	17.0	17.4	17.8	V
V _{EE}	Gate - supply voltage	V _{IN} =0V, f=0Hz	-5.5	-6.5	-7.5	V
V _{OH}	"H" Output voltage		14	15.5	16.5	V
V _{OL}	"L" Output voltage		-4.0	-5.0	-6.0	V
t _{PLH}	"L-H" Propagation time	I _{IH} =10mA	—	0.4	1	μs
t _r	"L-H" Rise time	I _{IH} =10mA	—	0.4	0.5	μs
t _{PHL}	"H-L" Propagation time	I _{IH} =10mA	—	1.3	2.0	μs
t _f	"H-L" Fall time	I _{IH} =10mA	—	0.4	0.5	μs
t _{timer}	Timer	Between start and cancel(Under input signal "L")	1.5	—	2.5	ms
I _{FO}	Fault output current	Applied 27pin R=470Ω	—	12	—	mA
t _c	Controlled time detect delay time	In the rise time 29pin :11V, 28pin :open	—	3.5	—	μs
t _d	Short-circuit protect delay time	In the rise time 29pin :11V, 28pin :open	—	6.5	—	μs
V _{CL}	Start voltage for protection at lower V _{CC}	The required minimum of positive power supply for gate when V _O is in the state of "H"	14.2	15.2	16.2	V
V _{SC}	Over-current detect voltage		11.0	11.6	12.2	V

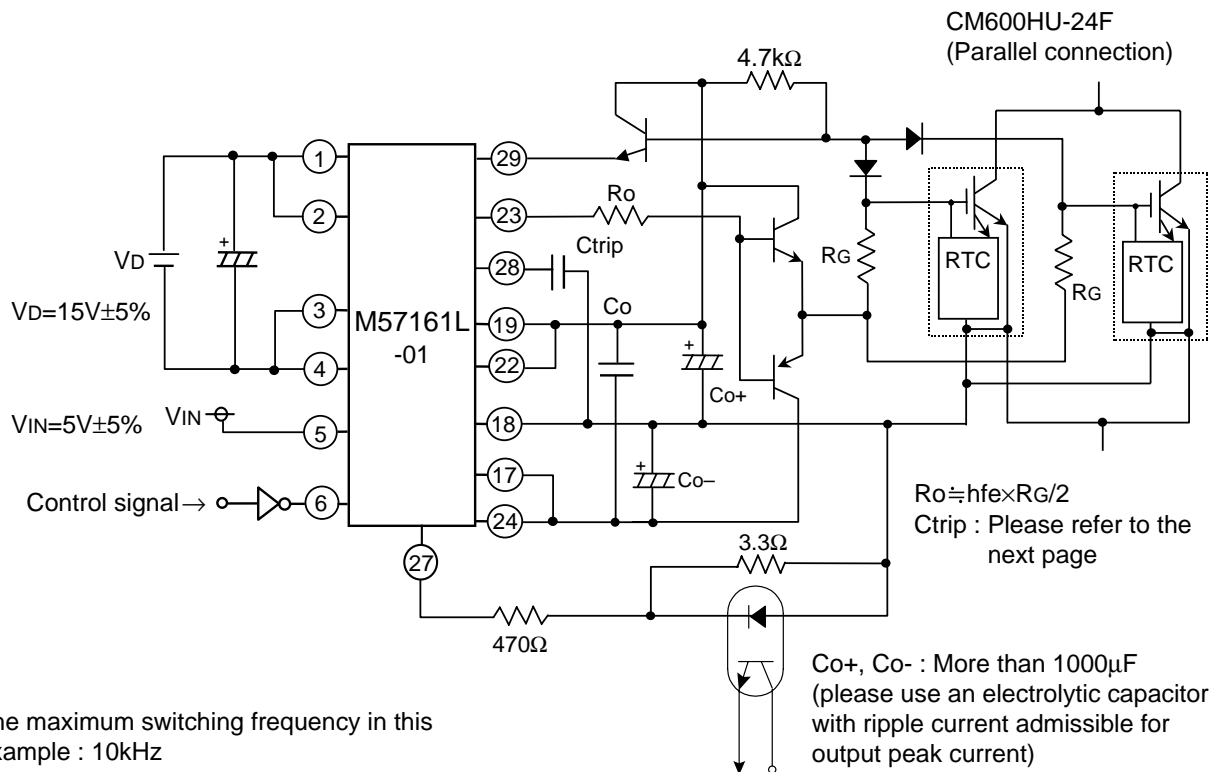
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APPLICATION CIRCUIT EXAMPLE 1 (Direct driving)

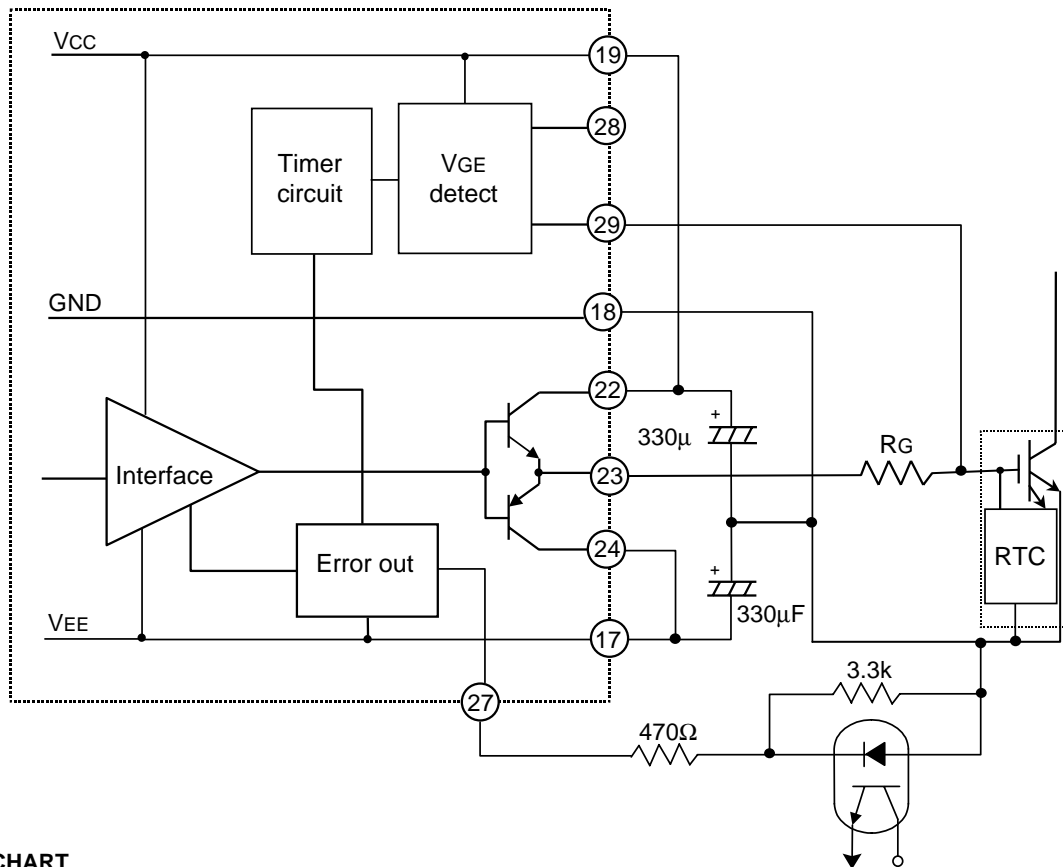


APPLICATION CIRCUIT EXAMPLE 2 (Additional transistor for output current)

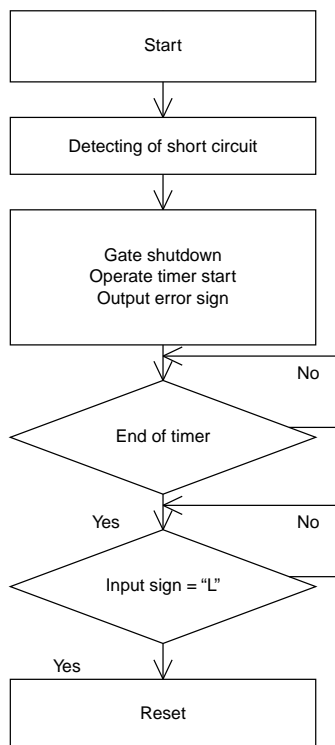


The maximum switching frequency in this example : 10kHz

OPERATION OF PROTECTION CIRCUIT



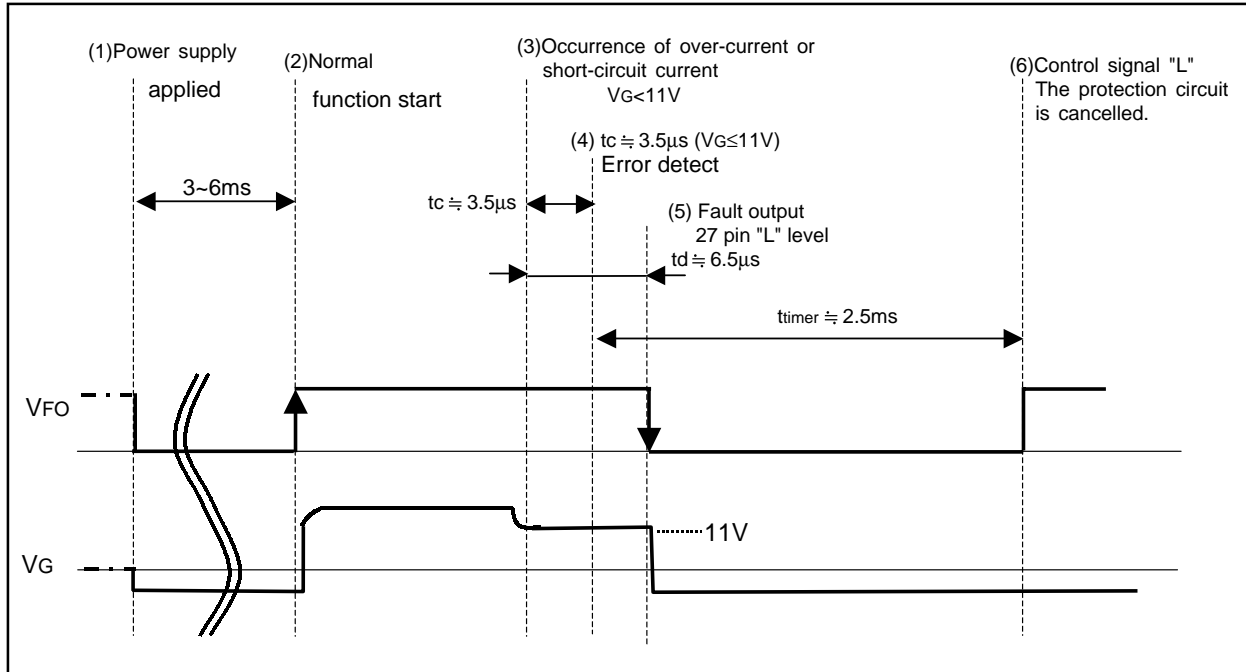
FLOW CHART



1. The V_{GE} error detect circuit operates when an input signal is in the state of "H".
2. An error judgment is made when V_{GE} becomes below V_{sc} ($\approx 11V$: min).
3. The V_{GE} error detect circuit does not function until the time when the gate voltage reaches V_{sc} ($\approx 12.2V$: max).
The t_c ($\approx 3.5\mu s$) of controlled time detect short circuit is set in order to ensure the turn-on of IGBT modules.
4. If a rise time of gate voltage is longer than $3.5\mu s$, the t_c can be adjusted by connecting a capacitor (C_{trip}) between pins 28 and 18. Please refer to t_d vs. C_{trip} CHARACTERISTICS on page 6/6.
5. The t_d is a delay time due to signal transmission of each protection circuit.
6. If short-circuit current flows at turn-on, the controlled time detect short circuit (t_d) is included to the t_d of short-circuit protect delay time.
The t_d can be changed through C_{trip} .
As a gate shutdown of IGBT modules within $10\mu s$ is recommended, C_{trip} should be below $220pF$ in order to set the maximum of t_d below $10\mu s$

CONTROL OF IGBT MODULE DRIVER

The timing chart for control of IGBT module drivers with electrical isolation between the input and output is as follows.



Timing chart when protection circuit operates under over-current (short circuit) with power supply applied.

DESCRIPTION OF TIMING CHART

- (1) When V_{CC} is within 10 to 15 voltages, S/C detect output (V_{FO}) is in the low state. The output voltage remains in the low state for 3 to 6 ms. If the power supply is applied in the high state of input signal, the output (V_o) remains in the low state. But V_{FO} becomes in the low state for 3 to 6 ms. After normal function starts, if V_{CC} is below the start voltage of protection circuit (Typ. 15.2V), V_{FO} is low and V_o is low voltage for the same period.
- (2) After V_{FO} returns to high level, control signal should be applied.
- (3) If over-current or short-circuit current flows between the collector and emitter of IGBT modules, the internal RTC circuit pulls the gate voltage down below 11V
- (4) When the turn-on of IGBT coincides with over-current or short-circuit current, the timer circuit functions after t_c .
- (5) After t_d from the short-circuit or over-current, the output voltage of V_o is low and V_{FO} is low voltage at the same time. The output remains low during the operating time of timer circuit regardless of input signals.
- (6) If the input signal is low level after t_{timer} , the protection function is cancelled. And then V_{FO} returns to high voltage.

CHARACTERISTICS CURVES

