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FGBS3040E1-F085
Integrated Smart Ignition Coil Driver

Features

- 400V 300mJ N Channel Ignition IGBT
- Control Input buffering
- Input spike filter of typical 13us
- Operation from Ignition or Battery line
- Ground shift tolerance +/- 1.5V
- Programmable maximum dwell time
- Current programmable bidirectional Input/Diagnostic pin
- Collector Current limit typical 16.5A
- Soft Shutdown of Collector Current after Max Dwell

Applications

- Coil on Plug Ignition systems
- General ignition systems

Description

The FGBS3040E1-F085 is designed to directly drive an ignition coil and control the current and spark event of the coil. The coil current is controlled via the input/diagnostic pin. When the input is driven high, the IGBT is enabled to start charging the coil. The FGBS3040E1-F085 will sink a current (IIN1) into the input to denote this condition. When the collector current increases to Icthr the input current into the FGBS3040E1-F085 is reduced to IIN2 indicating the collector current has reached this level. An input filter suppresses input signals of less then 13 µsec in duration. A Max Dwell timer is included in the FGBS3040E1-F085 which will turn off the IGBT if the input stays active for longer then the programmed time. This time interval can be modified through an external capacitor. When the Max Dwell timer is exceeded, the FGBS3040E1-F085 will enter a Soft-Shut-Down mode (SSD) slowly dropping the collector current thereby discharging the coil such as to inhibit a spark event. Once the soft shutdown operation has started, any transitions on the input signal are ignored until after completion of the soft shutdown function. The FGBS3040E1-F085 will also limit the collector current of the IGBT to Ic(lim) during charging.

September-2017, Rev. 2

Publication Order Number:
FGBS3040E1-F085/D

Block Diagram

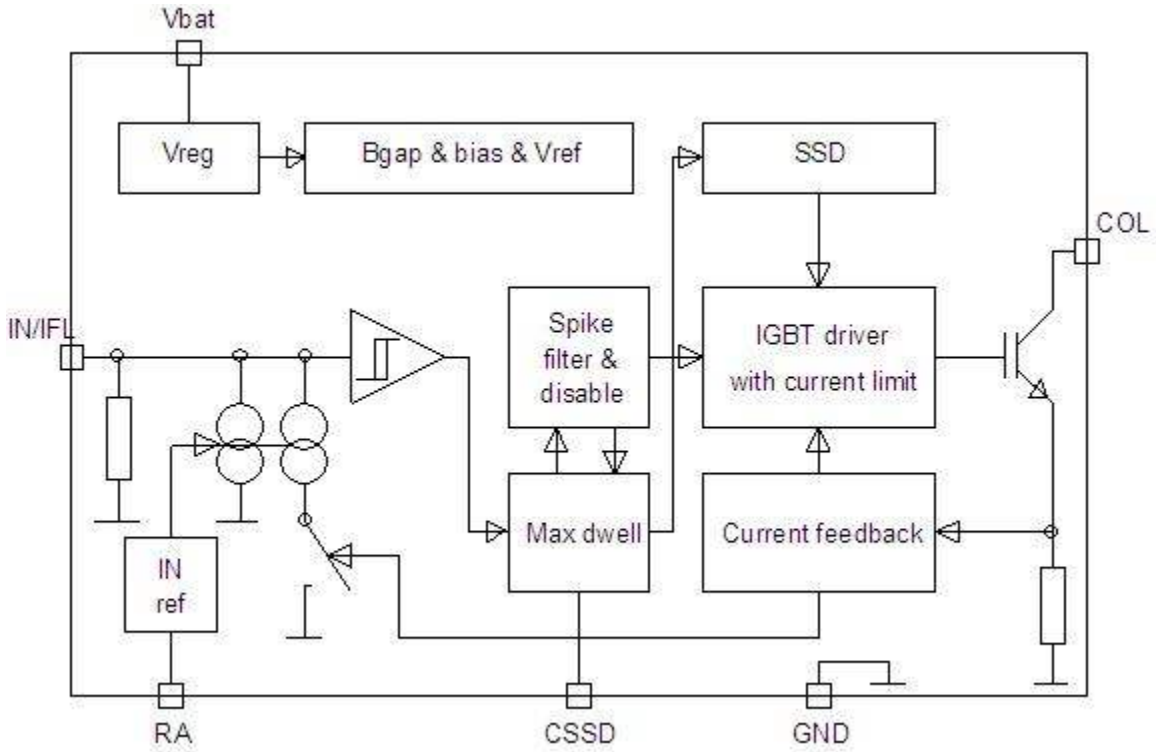
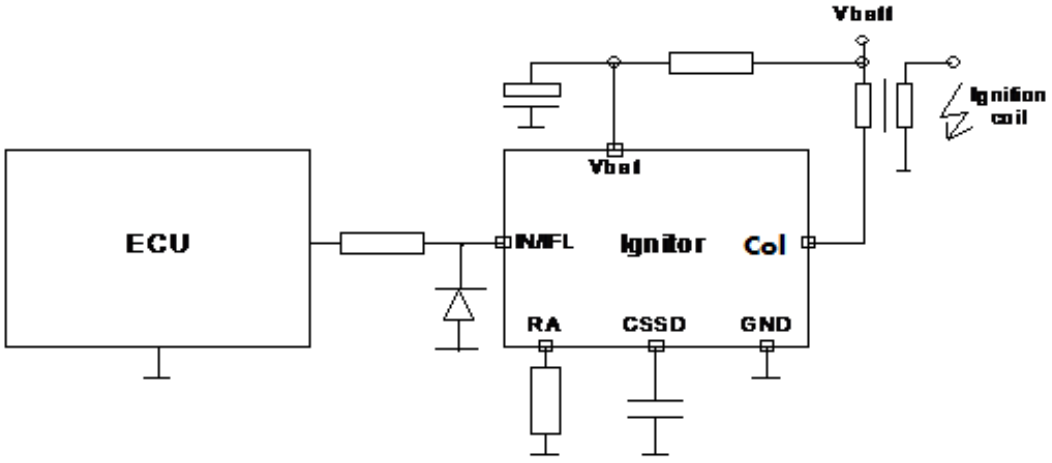


Figure 1. Block Diagram of FGBS3040E1-F085

Typical Application

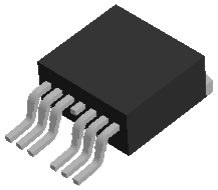
Figure 2. Typical Ignition Coil Driver Application



Pin Configuration

The FGBS3040E1-F085 is assembled in a 7 lead TO263 package

TO263-7L



Pin Assignment (Top Through View)

Pin1	GND	Emitter and control IC ground
Pin2	Vbat	Supply voltage
Pin3	IN/IFL	Input and diagnostic (bidirectional)
Pin4/Tab	COL	IGBT collector output
Pin5	NC	NC
Pin6	CSSD	Maximum dwell time and Soft-Shut-Down current output (to external capacitor)
Pin7	RA	Input reference current output (to external resistor)

Absolute Maximum Ratings[1]

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Parameter	Symbol	Values	Unit
Voltage at V_{bat} pin (excl. EMC transients)	V_{bat}	-0.3… 28	V
Voltage at IN/IFL pin	V_{IN1}	- 1... 16	V
Voltage at A & C_{SSD} pins	V_{IN2}	- 0.3... 6	V
Collector Emitter Voltage (V_{IN} = 0V) Ic=10mA	$V_{C-GND(CL)}$	450	V
Operating Temperature Range Storage Temperature Range	T_J T_{STG}	-40... +175 -40... +175	°C °C
Output Current	$I_{C(lim)}$	$I_{C(lim)}$ max	A
Self Clamped Inductive Switched Energy @Tj = 25°C	E_{AS}	300	mJ
Self Clamped Inductive Switched Energy @Tj = 150°C	E_{AS}	170	mJ
Maximum power dissipation (continuous) from TC = 25°C	P_{max}	150	W
Thermal Resistance junction–case (typical)	$R_{\Theta JC}$	1	°C /W
Electrostatic Discharge Voltage (Human Body Model) according to MIL STD 883D, method 3015.7 and EOS/ESD assn. standard S5.1 - 1993	V_{ESD} (pin to pin) V_{ESD} (CE)	2 4	kV kV

Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance. ON Semiconductor does not recommend exceeding them or designing to Absolute Maximum Ratings.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{INL}	Input low voltage	V_{bat} = 5 to 28 V; T_J= - 40 °C to + 175 °C (unless otherwise specified)	-0.3		2.05	V
V_{INH}	Input high voltage	V_{bat} = 5 to 28 V; T_J= - 40 °C to + 175 °C (unless otherwise specified)	2.85			V
V_{INHys}	Input voltage hysteresis	V_{bat} = 5 to 28 V; T_J= - 40 °C to + 175 °C (unless otherwise specified)	0.25			V
I_{IN1}	Input current (I_C < I_{cTHR})	See fig 8 for typical values vs Ra (Measured with 11.5k_, ±1% resistor on A pin)	16	18	20	mA
I_{IN2}	Input current (I_C > I_{cTHR})	See fig 8 for typical values vs Ra (Measured with 11.5k_, ±1% resistor on A pin)	6	7.1	10	mA
I_{IN1}	Input current (I_C < I_{cTHR})	**(Note 1)**		4.2		mA
I_{IN2}	Input current (I_C > I_{cTHR})	**(Note 1)**		1.8		mA
C_{oss}	Output capacitance	V_{C-GND} = 25 V, V_{IN} = 0 V, f = 1 MHz		70		pF
Ic_{THR}	Collector current feedback (IFL) threshold 25 C to 175C	(Measured with 11.5k_, ±1% resistor on A pin)	4.3	5.3	6.8	A
Ic_{THR} *Note 3*	Collector current feedback (IFL) threshold -40C	(Measured with 11.5k_, ±1% resistor on A pin)	4.3		7.3	A
RA	Resistor for input reference current		5.2		200	kΩ
$CSSD_{MIN}$	Minimum dwell time capacitor			2.2		nF
T_{DMAX}	Maximum dwell time	($CSSD_{EXT}$=10nF)	19	23	28	ms
I_{SLEW}	Soft-Shut-Down slew rate	(I_c: 90% -20%I_L)	0.7	1.5	2.5	A/ms
I_{CSSD1}	CSSD Pin current for T_{DMAX}		1.0	1.25	1.5	µA

Electrical Characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{bat1}	Operating voltage	Coil switching	4		28	V
V_{bat2}	Operating voltage	All functions	5		28	V
I_{bat}	Supply current	(T_J=175°C, Vbat = 28V, RA open, IN/IFL = 5V)			5	mA
$V_{C\text{-}GND(CL)}$	Collector emitter clamping voltage	(I_C = 10 mA)	390		450	V
$I_{C(leak)}$	Collector leakage current	(T_J=175°C,$V_{C\text{-}GND}$=300 V)			30	µA
$V_{C\text{-}GND(SAT)}$	Collector emitter saturation voltage (Ic=10A, Tj=175°C)	Collector emitter saturation voltage (Ic=10A, Tj=175°C)			1.8	V
$I_{C(lim)}$	Current Limit	**(Note 2)**	14		19	A
T_{fall}	Current fall time	Current fall time			15	µs
T_{spike}	Input spike filter delay on rising and falling edge of IN/IFL	Input spike filter delay on rising and falling edge of IN/IFL		13		µs
T_{D1}	Turn on delay time (Time from VIN/IFL=4.0 V to Vc-gnd=Vbat/2)	Turn on delay time (Time from VIN/IFL=4.0 V to Vc-gnd=Vbat/2)	10	13	26	µs
T_{D2}	Turn off delay time (Time from VIN/IFL=0.5 V to Vc-gnd=Vbat/2)	Turn off delay time (Time from VIN/IFL=0.5 V to Vc-gnd=Vbat/2)	10	17	28	µs

Notes:

1. Measured with open or shorted RA pin
2. Range can be varied between typ. 8-16.5A or can be eliminated with metal mask options
3. Icth max < 7.3A- 0.0077*(T+40C) for Tj from -40 to 25C

Functional Description

Input and spike filter

When the input signal voltage reaches VINH, the coil current will be switched on through the IGBT. When the input voltage goes below VINL, the coil current through the IGBT will be turned off. If the ignitor is in SSD mode, the input signal control is disabled. After a SSD sequence input control will be re-enabled after the input has reached a valid low. Positive and negative spikes of < Tspike duration at the input line will be filtered out and will not turn on/off the IGBT.

Bidirectional input / diagnosis pin

The pin IN/IFL has a double function. It is used as input pin to control the power stage (on/off) and as output pin that delivers diagnostic information about the collector current level (current flag).

a) If the input voltage reaches VINH, the power stage is turned on. If the input voltage is below VINL, the power stage is turned off.

b) The IN/IFL pin sinks constantly a current of IIN1. When the input voltage is above VINH and the collector current exceeds the IcTHR threshold, the current flag is set by switching a current sink at the bidirectional IN/IFL pin to IIN2 (see Fig.4)

c) If resistor RA has a value <5.2k or >200k, IIN1 and IIN2 will be set to their default values.

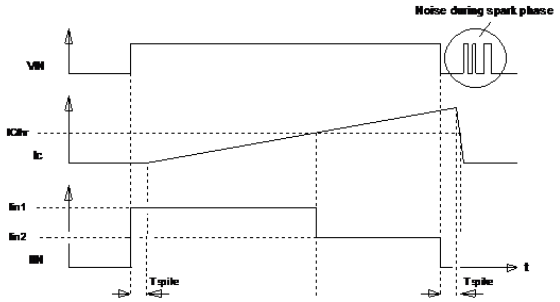


Figure 4: Bidirectional IN/INFL Diagnostic Pin

Maximum dwell time and soft-shutdown (SSD)

When the IGBT is turned on, a delay timer, dependent on the value of the external CSSD capacitor (see Fig.6), is started. If a valid falling edge has not been received after the time T_{DMAX}, the IGBT will be turned off slowly as shown in Fig.5. The coil current will not exceed a slew rate of typical 1.2A/ms. If a valid falling edge is received after the time T_{DMAX}, the edge will be ignored and the soft shutdown will be completed. The IGBT cannot be subsequently turned on until a valid rising edge is detected.

If the CSSD capacitor has a value of < 2.2nF or the CSSD pin is shorted to ground, the maximum dwell time and SSD functions will be disabled.

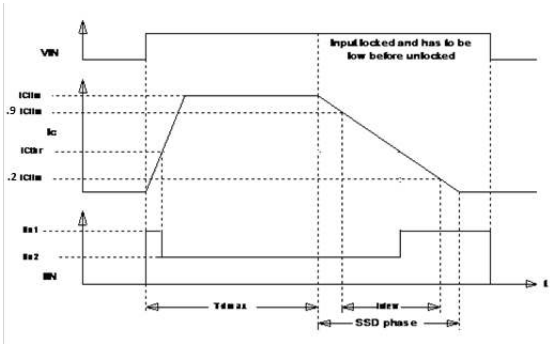


Figure 5: Dwell time and Soft-Shut-Down

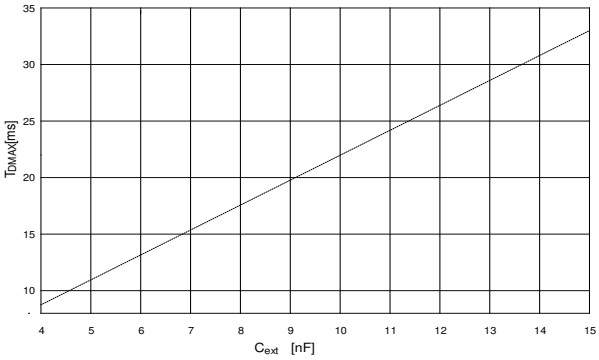


Figure 6: T_{DMAX} as function of external CSSD capacitor

Figure 7 shows the IN1 and IN2 currents in dependency of the IRA current.

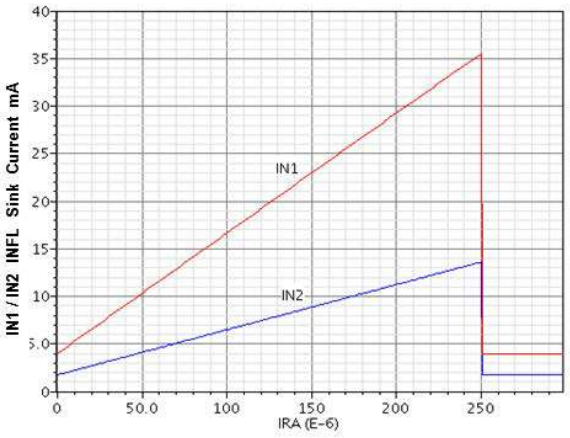


Figure 7: Typical IN1 and IN2 Currents vs Ra
The value for RA can be determined by the formula:
RA = (1.24/IRA)-750.

Physical Dimensions

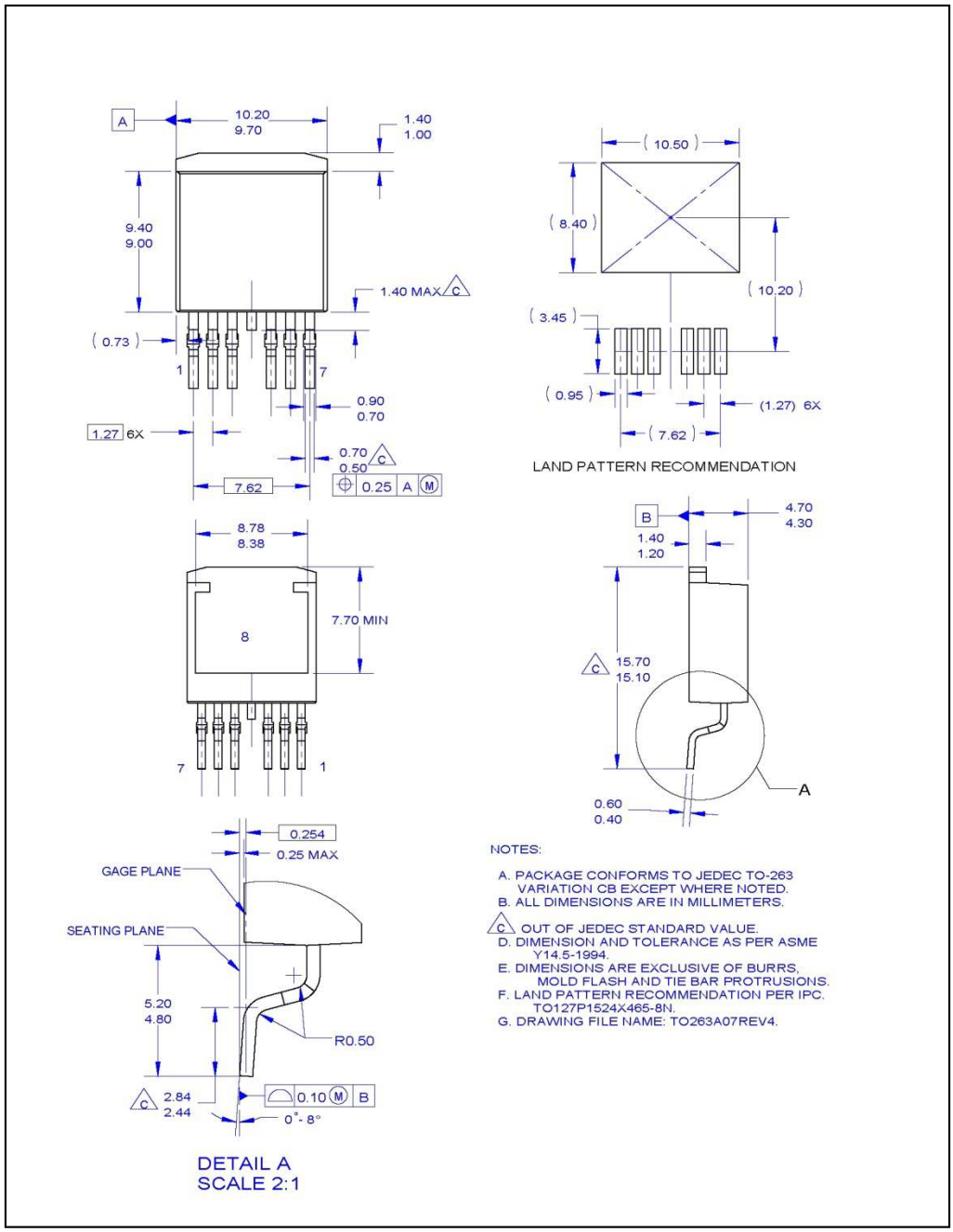


Figure 3. Packaging Outline and Dimensions (TO263A07 Rev4)

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