APPLICATION NOTE

CONFIDENTIAL

Revision -

Prepared by	T.Matsuoka
Checked by	H.Nakanishi
Approved by	M.Yamamoto
Date	29-Sep-'10

PRELIMINARY

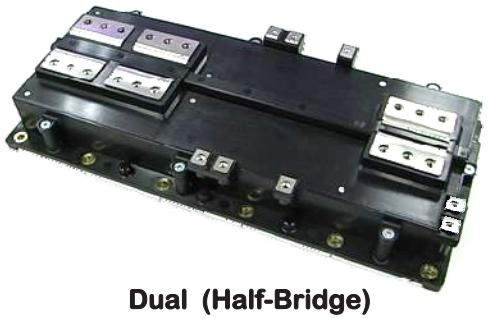
MITSUBISHI IGBT MODULES

CM2500DY-24S

HIGH POWER SWITCHING USE INSULATED TYPE

Notice: This is not a final specification. Some parametric limits are subject to change.

2500A/1200V



Dual (Half-Bridge)

- Using New IGBT and FWDi -

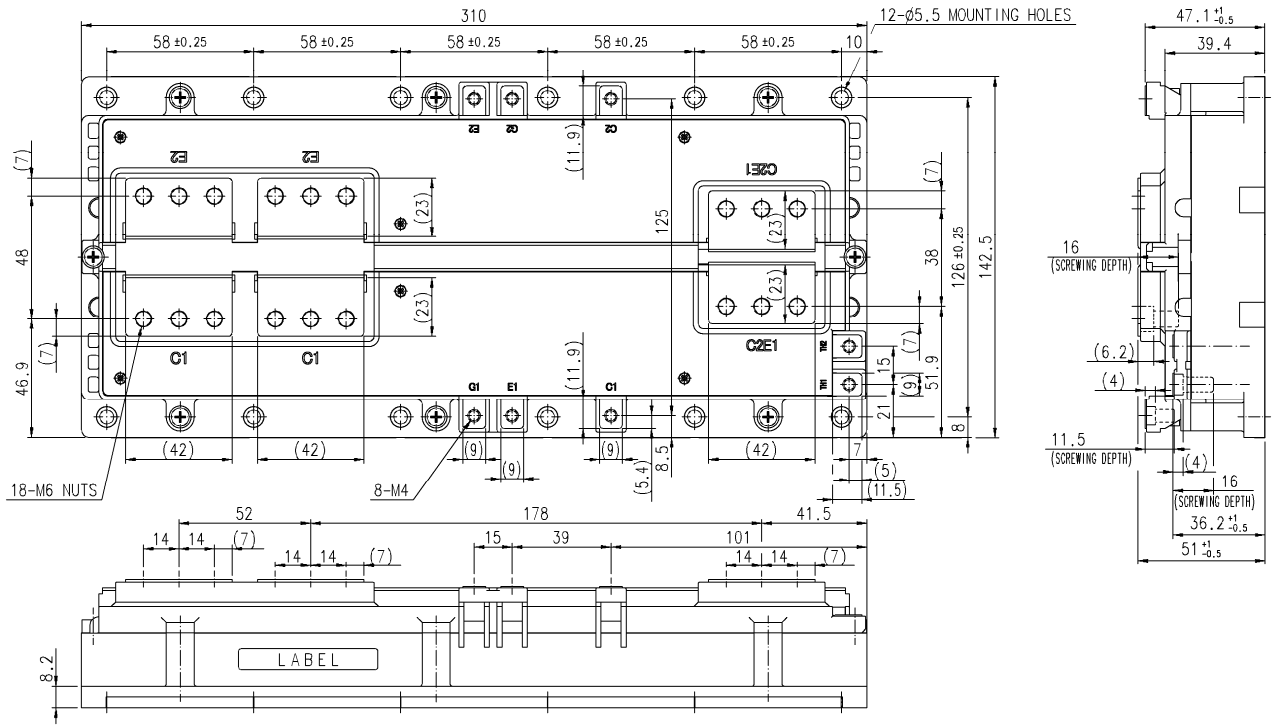
- I_C ..... 2500 A
- V_{CES} ..... 1200 V
- Flat base Type
  Alminium base plate
- RoHS Directive compliant
- UL under application

APPLICATION

Wind power, AC Motor Control, Power supply, etc.

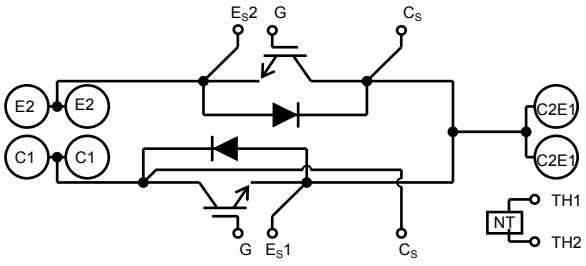
OUTLINE DRAWING & CIRCUIT DIAGRAM

Dimension in mm



Tolerance otherwise specified	
Division of Dimension	Tolerance
0.5 to 3	±0.2
over 3 to 6	±0.3
over 6 to 30	±0.5
over 30 to 120	±0.8
over 120 to 400	±1.2

CIRCUIT DIAGRAM



Note: Main terminal pair should be connected together in case of the current through it.

PRELIMINARY

ABSOLUTE MAXIMUM RATINGS (T_j=25 °C, unless otherwise specified)

Inverter IGBT/FWDi part

Symbol	Item	Conditions	Ratings	Unit
V_{CES}	Collector-emitter voltage	G-E short-circuited	1200	V
V_{GES}	Gate-emitter voltage	C-E short-circuited	±20	V
I_C	Collector current	DC, T_C=62 °C (Note.2)	2500	A
I_{CRM}		Pulse (Note.3)	5000	
P_{tot}	Total power dissipation	T_C=25 °C (Note.2, 4)	9350	W
I_E (Note.1)	Emitter current (Free wheeling diode forward current)	T_C=25 °C (Note.2, 4)	2500	A
I_{ERM} (Note.1)		Pulse (Note.3)	5000	

Module

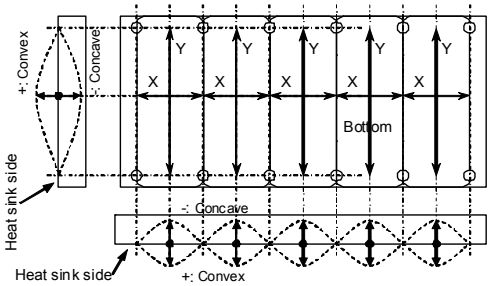
Symbol	Item	Conditions	Ratings	Unit
T_{jmax}	Maximum junction temperature	-	+175	°C
T_{jop}	Operating junction temperature	-	-40 ~ +150	
T_{stg}	Storage temperature	-	-40 ~ +125	
T_C	Case temperature	-	-40 ~ +125	
V_{isol}	Isolation voltage	Terminals to base plate, f=60 Hz, AC 1 minute	2500	V_{rms}

Note.1: Represent ratings and characteristics of the anti-parallel, emitter-collector free wheeling diode (FWDi).
Note.2: Case temperature (T_C) and heat sink temperature (T_s) are defined on the each surface of base plate and heat sink just under the chips. (Refer to the figure of chip location)
Note.3: Pulse width and repetition rate should be such that the device junction temperature (T_j) dose not exceed T_{jmax} rating.
Note.4: Junction temperature (T_j) should not increase beyond T_{jmax} rating.

MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
M_t	Mounting torque	Main terminals M 6 screw	3.5	4.0	4.5	N·m
M_t		Auxiliary terminals M 4 screw	1.3	1.5	1.7	
M_s		Mounting M 5 screw	2.5	3.0	3.5	
d_s	Creepage distance	Terminal to terminal	16	-	-	mm
		Terminal to base plate	25	-	-	
d_a	Clearance	Terminal to terminal	16	-	-	mm
		Terminal to base plate	24	-	-	
m	Weight	-	-	2000	-	g
e_c	Flatness of base plate	On the centerline X, Y (Note.5)	-50	-	+100	μm

Note.5: Base plate flatness measurement point is as in the following figure.



PRELIMINARY

ELECTRICAL CHARACTERISTICS (T_j=25 °C, unless otherwise specified)

Inverter IGBT/FWDi part

Symbol	Item	Conditions		Limits			Unit
				Min.	Typ.	Max.	
I_{CES}	Collector-emitter cut-off current	V_{CE}=V_{CES}, G-E short-circuited		-	-	1	mA
I_{GES}	Gate-emitter leakage current	±V_{GE}=V_{GES}, C-E short-circuited		-	-	5	μA
$V_{GE(th)}$	Gate-emitter threshold voltage	I_C=250 mA, V_{CE}=10 V		5.4	6.0	6.6	V
V_{CEsat}	Collector-emitter saturation voltage	I_C=2500 A (Note.6), V_{GE}=15 V, Terminal	T_j=25 °C	-	2.00	2.45	V
			T_j=125 °C	-	2.20	-	
			T_j=150 °C	-	2.25	-	
		I_C=2500 A, V_{GE}=15 V, Chip	T_j=25 °C	-	1.70	2.15	V
			T_j=125 °C	-	1.90	-	
			T_j=150 °C	-	1.95	-	
C_{ies}	Input capacitance	G-E short-circuited, V_{CE}=10 V		-	-	250	nF
C_{oes}	Output capacitance			-	-	50	
C_{res}	Reverse transfer capacitance			-	-	4.2	
Q_G	Gate charge	V_{CC}=600 V, I_C=2500 A, V_{GE}=15 V		-	5800	-	nC
$t_{d(on)}$	Turn-on delay time	V_{CC}=600 V, I_C=2500 A, V_{GE}=±15 V, R_G=0 Ω, Inductive load		-	-	800	ns
t_r	Rise time			-	-	200	
$t_{d(off)}$	Turn-off delay time			-	-	700	
t_f	Fall time			-	-	300	
t_{rr} (Note.1)	Reverse recovery time	V_{CC}=600 V, I_E=2500 A, V_{GE}=15 V, R_G=0 Ω, Inductive load		-	-	300	
Q_{rr} (Note.1)	Reverse recovery charge			-	70	-	μC
E_{on}	Turn-on switching energy	V_{CC}=600 V, I_C=I_E=2500 A, V_{GE}=±15 V, R_G=0 Ω, T_j=150 °C, Inductive load, Per pulse		-	214	-	mJ
E_{off}	Turn-off switching energy			-	304	-	
E_{rr} (Note.1)	Reverse recovery energy			-	210	-	
V_{EC} (Note.1)	Emitter-collector voltage	I_E=2500 A (Note.6), V_{GE}=0 V, Terminal,	T_j=25 °C	-	2.0	2.45	V
			T_j=125 °C	-	2.0	-	
			T_j=150 °C	-	2.0	-	
		I_E=2500 A, V_{GE}=0 V, Chip	T_j=25 °C	-	1.7	2.25	V
			T_j=125 °C	-	1.7	-	
			T_j=150 °C	-	1.7	-	
$R_{CC'+EE'}$	Internal lead resistance	Main terminals-chip, per switch, T_C=25 °C (Note.2)		-	0.11	-	mΩ
r_g	Internal gate resistance	Per switch		-	1.1	-	Ω

NTC thermistor part

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R_{25}	Zero power resistance	T_C=25 °C (Note.2)	4.85	5.00	5.15	kΩ
ΔR/R	Deviation of resistance	T_C=100 °C, R_{100}=493 Ω	-7.3	-	+7.8	%
$B_{(25/50)}$	B constant	Approximate by equation (Note.7)	-	3375	-	K
P_{25}	Power dissipation	T_C=25 °C (Note.2)	-	-	10	mW

Note.1: Represent ratings and characteristics of the anti-parallel, emitter-collector free wheeling diode (FWDi).

Note.2: Case temperature (T_C) and heat sink temperature (T_s) are defined on the each surface of base plate and heat sink just under the chips. (Refer to the figure of chip location)

Note.3: Pulse width and repetition rate should be such that the device junction temperature (T_j) dose not exceed T_{jmax} rating.

Note.4: Junction temperature (T_j) should not increase beyond T_{jmax} rating.

Note.6: Pulse width and repetition rate should be such as to cause negligible temperature rise. (Refer to the figure of test circuit)

Note.7: $B_{(25/50)} = \ln(\frac{R_{25}}{R_{50}}) / (\frac{1}{T_{25}} - \frac{1}{T_{50}})$

R_{25}: resistance at absolute temperature T_{25} [K]; T_{25}=25 [°C]+273.15=298.15 [K]

R_{50}: resistance at absolute temperature T_{50} [K]; T_{50}=50 [°C]+273.15=323.15 [K]

PRELIMINARY

THERMAL RESISTANCE CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$R_{th(j-c)Q}$	Thermal resistance (Note.2)	Junction to case, per Inverter IGBT	-	-	16	K/kW
$R_{th(j-c)D}$		Junction to case, per Inverter FWDi	-	-	27	K/kW
$R_{th(c-s)}$	Contact thermal resistance (Note.2, 9)	Case to heat sink, per 1 module, Thermal grease applied (Note.8)	-	3.1	-	K/kW

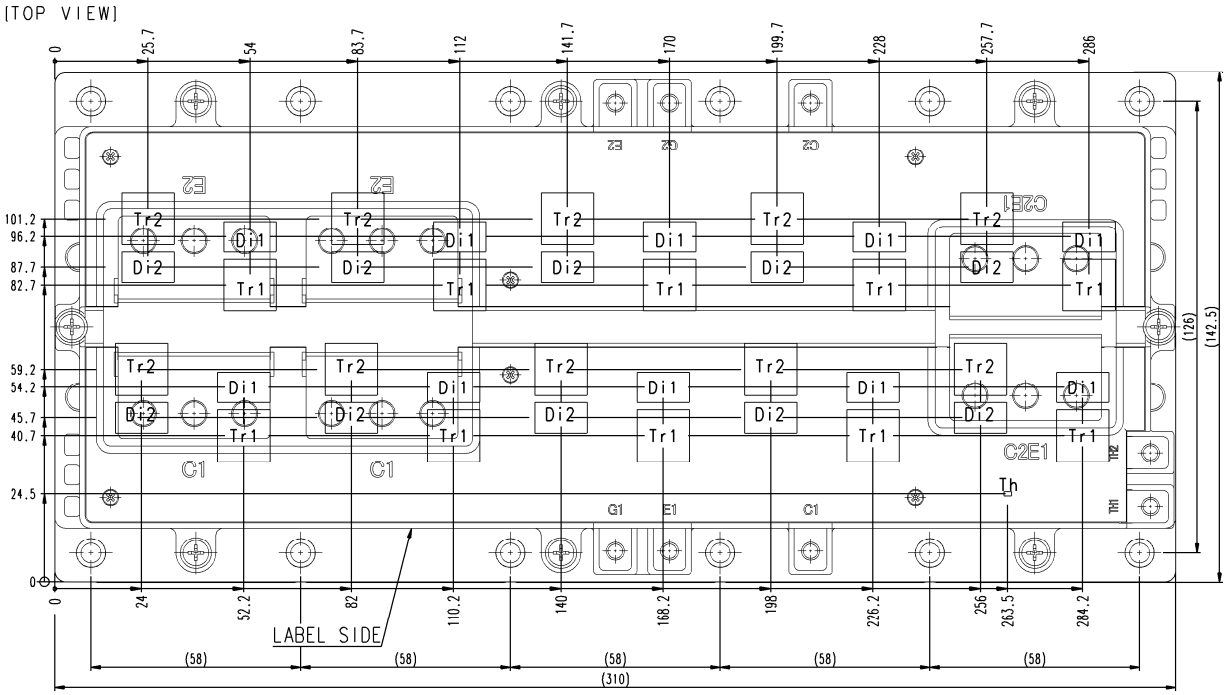
Note.2: Case temperature (T_C) and heat sink temperature (T_s) are defined on the each surface of base plate and heat sink just under the chips. (Refer to the figure of chip location)

Note.8: Typical value is measured by using thermally conductive grease of λ=0.9 W/(m·K).

Note.9: When liquid-cooling, actual $R_{th(c-s)}$ should be used by measurement on each heat sink.

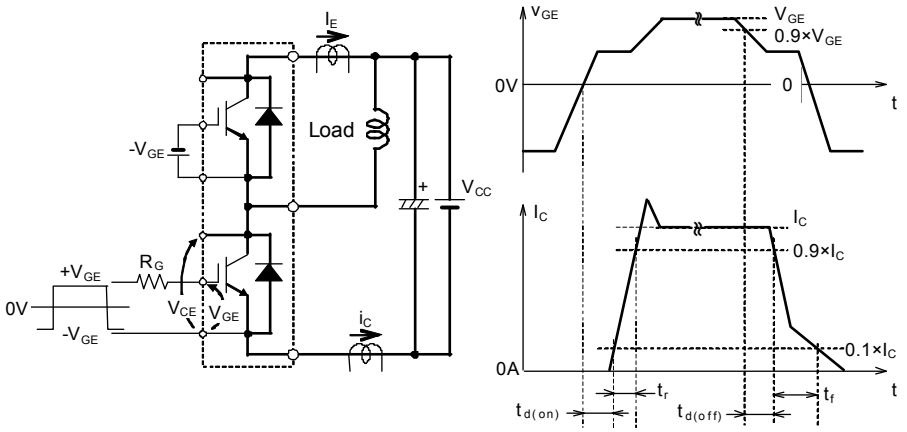
CHIP LOCATION (Top view)

Dimension in mm (tolerance: ±1 mm)

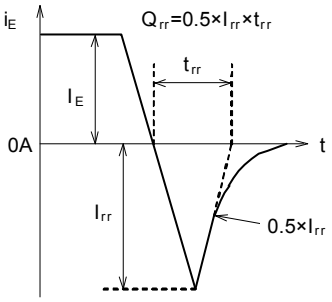


Each mark points the center position of each chip. Tr1/Tr2: IGBT, Di1/Di2: FWDi, Th: Thermistor

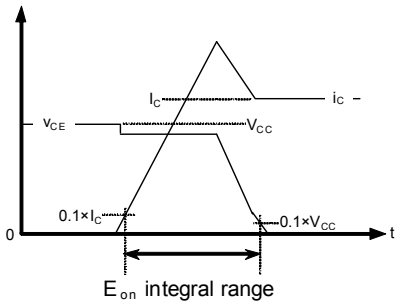
TEST CIRCUIT and WAVEFORMS



Switching time test circuit and waveforms

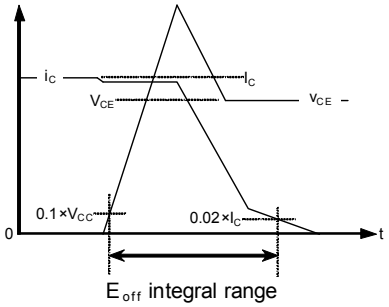


t_{rr}, Q_{rr} test waveform



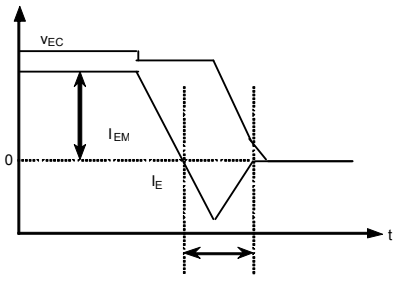
E_{on} integral range

IGBT Turn-on energy



E_{off} integral range

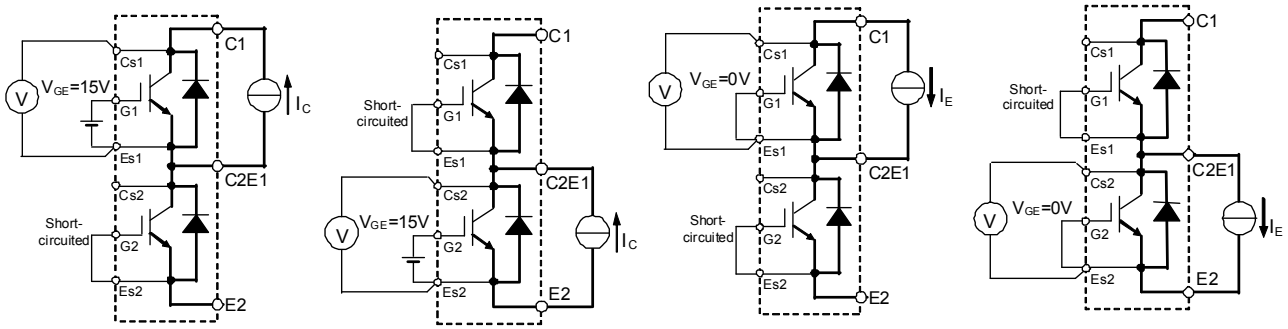
IGBT Turn-off energy



E_{rr} integral range

FWDi reverse recovery energy

Switching energy (per pulse) test waveforms



Tr1 Tr2 Di1 Di2

V_{CEsat} test circuit

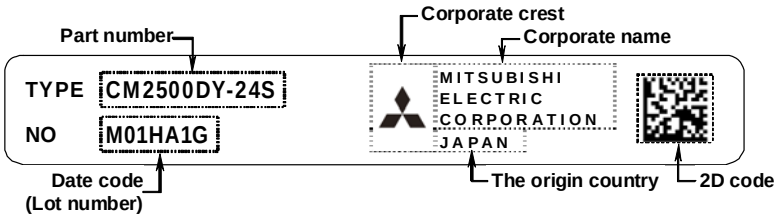
V_{EC} test circuit

PRELIMINARY

RECOMMENDED OPERATING CONDITIONS (T_a=25 °C, unless otherwise specified)

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V_{CC}	DC supply voltage	Applied across P-N terminals	-	600	850	V
V_{GEon}	Gate-emitter drive voltage	Applied across G-E terminals	13.5	15.0	16.5	
R_G	External gate resistance	-	0	-	(2)	Ω

LABEL EXAMPLE and 2D CODE SPECIFICATION



2D code specification

Item	Specification
Symbology	Data Matrix (ECC200)
Data type	alphanumeric (ASCII) character
Error correction ability	20 ~ 35 %
Symbol size	6.0 mm × 6.0 mm
Cell size	0.25 mm
Code size	24 cell × 24 cell
Data size	32 characters

Data contents

Item	letter size
Part number	20
Space	2
Date code	8
Space	2
total	32

Data contents example("sp" means space, equivalent to ASCII code number 32)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
C	M	2	5	0	0	D	Y	-	2	4	S	sp	sp	sp	sp	sp	sp	sp	sp	sp	sp	M	0	1	H	A	1	G	sp	sp	sp

Keep safety first in your circuit designs!

·Mitsubishi Electric Corporation puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage.
Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of non-flammable material or (iii) prevention against any malfunction or mishap.

Notes regarding these materials

·These materials are intended as a reference to assist our customers in the selection of the Mitsubishi semiconductor product best suited to the customer's application; they do not convey any license under any intellectual property rights, or any other rights, belonging to Mitsubishi Electric Corporation or a third party.

·Mitsubishi Electric Corporation assumes no responsibility for any damage, or infringement of any third-party's rights, originating in the use of any product data, diagrams, charts, programs, algorithms, or circuit application examples contained in these materials.

·All information contained in these materials, including product data, diagrams, charts, programs and algorithms represents information on products at the time of publication of these materials, and are subject to change by Mitsubishi Electric Corporation without notice due to product improvements or other reasons. It is therefore recommended that customers contact Mitsubishi Electric Corporation or an authorized Mitsubishi Semiconductor product distributor for the latest product information before purchasing a product listed herein.
The information described here may contain technical inaccuracies or typographical errors. Mitsubishi Electric Corporation assumes no responsibility for any damage, liability, or other loss rising from these inaccuracies or errors.
Please also pay attention to information published by Mitsubishi Electric Corporation by various means, including the Mitsubishi Semiconductor home page (http://www.mitsubishichips.com/Global/index.html).

·When using any or all of the information contained in these materials, including product data, diagrams, charts, programs, and algorithms, please be sure to evaluate all information as a total system before making a final decision on the applicability of the information and products. Mitsubishi Electric Corporation assumes no responsibility for any damage, liability or other loss resulting from the information contained herein.

·Mitsubishi Electric Corporation semiconductors are not designed or manufactured for use in a device or system that is used under circumstances in which human life is potentially at stake. Please contact Mitsubishi Electric Corporation or an authorized Mitsubishi Semiconductor product distributor when considering the use of a product contained herein for any specific purposes, such as apparatus or systems for transportation, vehicular, medical, aerospace, nuclear, or undersea repeater use.

·The prior written approval of Mitsubishi Electric Corporation is necessary to reprint or reproduce in whole or in part these materials.

·If these products or technologies are subject to the Japanese export control restrictions, they must be exported under a license from the Japanese government and cannot be imported into a country other than the approved destination.
Any diversion or reexport contrary to the export control laws and regulations of Japan and/or the country of destination is prohibited.

·Please contact Mitsubishi Electric Corporation or an authorized Mitsubishi Semiconductor product distributor for further details on these materials or the products contained therein.

Date of publication: 2010-9-24