Darlington Transistor Arrays — *At a Glance*

Page	Device	Case (ns)	Polarity	Maximum Ratings V_{CEO} (V)	I_C (A)
3–9	FT5753M	RM–65	NPN	100	±1.5
	FT5756M		NPN	100	±1.5
3–11	FT5754M	RM–65	NPN	100	±3
	FT5757M		NPN	100	±3
3–13	FT5755M	RM–65	NPN	100	±5
	FT5758M		NPN	100	±5
3–15	FT5759M	RM–65	PNP	–100	±1.5
3–17	FT5760M	RM–65	PNP	–100	±3
3–19	FT5761M	RM–65	PNP	–100	±5
3–21	FT5763M	RM–67	NPN	100	±1.5
	FT5766M		NPN	100	±1.5
3–23	FT5764M	RM–67	NPN	100	±3
	FT5767M		NPN	100	±3
3–25	FT5769M	RM–67	PNP	–100	±1.5
3–27	FT5770M	RM–67	PNP	–100	±3
3–29	FT5776M	RM–65	NPN/PNP	100 –100	±1.5
3–33	FT5777M	RM–65	NPN/PNP	100 –100	±3
3–37	FT5778M	RM–65	NPN/PNP	100 –100	±5
3–41	FT5786M	RM–67	NPN/PNP	100 –100	±1.5
3–45	FT5787M	RM–67	NPN/PNP	100 –100	±3

3

INTRODUCTION

DARLINGTON TRANSISTOR ARRAY SERIES

Description

This series is Silicon Darlington Transistor Arrays. Each array consists of 4-Darlington Transistors. The array is packaged in a small plastic 12-pin single in-line package with or without an isolated heatsink.
The series is well suited for motor drive applications where IC outputs must be boosted to drive print hammers. The series are extremely cost effective and space saving compared to using four separate TO-220 type Darlington transistors.

Features

- 4-Circuits included in one package
- Large DC Current Gain
- Large Collector Power Dissipation
- Fastrecovery diode included to absorb fly-back voltage
- Fast switching speed

Application

- Solenoid Drives — Printer Head Drives, Hummer Drives
- Motor Drives
- Amplifiers

Outline of the series

Device Type	Diode*	I_C = 1.5A	I_C = 3.0A	I_C = 5.0A
NPN 2 devices + 2 devices	Yes	FT5753M FT5763M Circuit A	FT5754M FT5764M Circuit A	FT5755M Circuit B
NPN 4 device independent	No	FT5756M FT5766M Circuit C	FT5757M FT5767M Circuit C	FT5758M Circuit D
PNP 4 device independent	No	FT5759M FT5769M Circuit E	FT5760M FT5770M Circuit E	FT5761M Circuit E
NPN + PNP 2NPN + 2PNP independent	No	FT5776M FT5786M Circuit F	FT5777M FT5787M Circuit F	FT5778M Circuit F

* Diode: Fast recovery diode which absorb fly back energy.

DARLINGTON TRANSISTOR ARRAY SERIES

- **Selection Guide**

RM-65 Series

Device Number		V_{CBO} ((V)	V_{CEO} (V)	I_C DC (A)	I_{CP} Pulsed (A)	*P_T Ta = 25°C (W)	*P_T Tc = 25°C (W)	h_{FE} TYP.	PAGE
NPN	FT5753M	150	100	±1.5	±3	4	19	6000	3-9
	FT5754M	150	100	±3	±5	5	21	6000	3-11
	FT5755M	150	100	±5	±8	5	25	4000	3-13
	FT5756M	150	100	±1.5	±3	4	19	6000	3-9
	FT5757M	150	100	±3	±5	5	21	6000	3-11
	FT5758M	150	100	±5	±8	5	25	4000	3-13
PNP	FT5759M	-100	-100	±1.5	±3	4	19	6000	3-15
	FT5760M	-100	-100	±3	±5	5	21	6000	3-17
	FT5761M	-100	-100	±5	±8	5	25	6000	3-19
NPN + PNP	FT5776M	100 -100	100 -100	±1.5	±3	4	19	6000	3-29
	FT5777M	100 -100	100 -100	±3	±5	5	21	6000	3-33
	FT5778M	100 -100	100 -100	±5	±8	5	25	6000	3-37

*4 Darlington Transistors

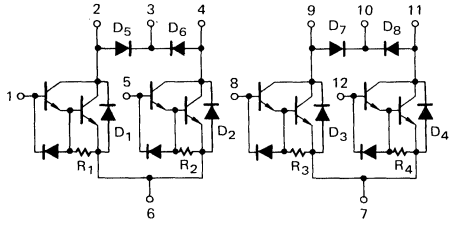
RM-67 Series

Device Number		V_{CBO} (V)	V_{CEO} (V)	I_C DC (A)	I_{CP} Pulsed (A)	*P_T Ta = 25°C (W)	*P_T Tc = 25°C (W)	h_{FE} TYP.	PAGE
NPN	FT5763M	150	100	±1.5	±3	3.5	17	6000	3-21
	FT5764M	150	100	±3	±5	4	19	6000	3-23
	FT5766M	150	100	±1.5	±3	3.5	17	6000	3-21
	FT5767M	150	100	±3	±5	4	19	6000	3-23
PNP	FT5769M	-100	-100	±1.5	±3	3.5	17	6000	3-25
	FT5770M	-100	-100	±3	±5	4	19	6000	3-27
NPN + PNP	FT5786M	100 -100	100 -100	±1.5	±3	3.5	17	6000	3-41
	FT5787M	100 -100	100 -100	±3	±5	4	19	6000	3-45

*4 Darlington Transistors

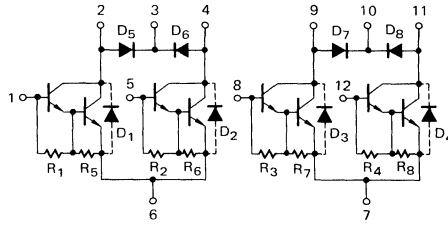
CIRCUIT AND PIN ASSIGNMENT

A



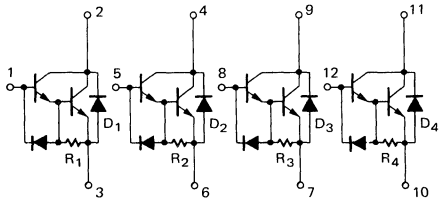
13: FIN (N.C.)
$D_1 \sim D_4$: Flywheel diode
$D_5 \sim D_8$: Fast recovery diode to absorb fly-back voltage
$R_1 \sim R_4$: ~100Ω

B



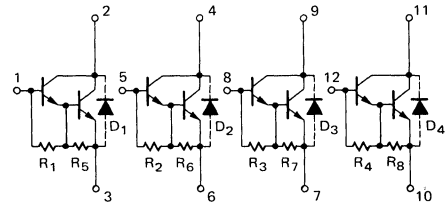
13: FIN (N.C.)
$D_1 \sim D_4$: Flywheel diode
$D_5 \sim D_8$: Fast recovery diode to absorb fly-back voltage
$R_1 \sim R_4$: ≒ 2 kΩ
$R_5 \sim R_8$: ≒ 200Ω

C



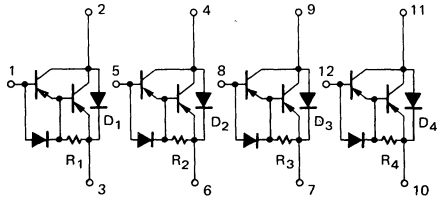
13: Fin (N.C.)
$D_1 \sim D_4$: Flywheel diode
$R_1 \sim R_4$: ~100Ω

D

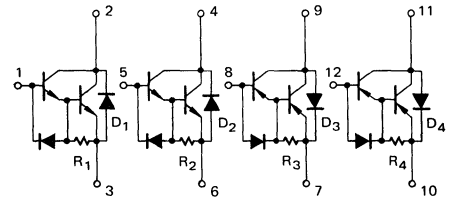


13: Fin (N.C.)
$D_1 \sim D_4$: Flywheel diode
$R_1 \sim R_4$: ≒ 2 kΩ
$R_5 \sim R_8$ ≒ 200Ω

E



F

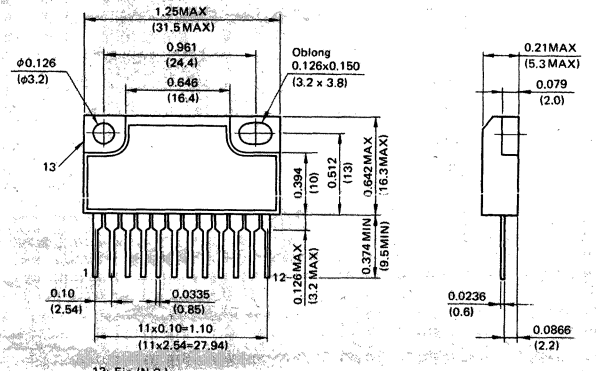


13: Fin (N.C.)
$D_1 \sim D_4$: Flywheel diode

3

PACKAGE DIMENSIONS

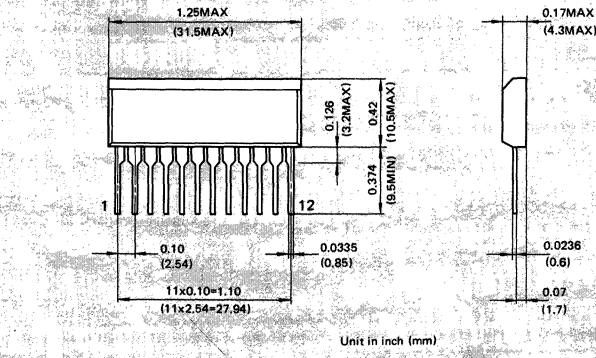
FUJITSU PKG No. RM-65



13: Fin (N.C.)

Unit in inch (mm)

FUJITSU PKG No. RM-67



Unit in inch (mm)

Applications for solenoid drives and motor drives

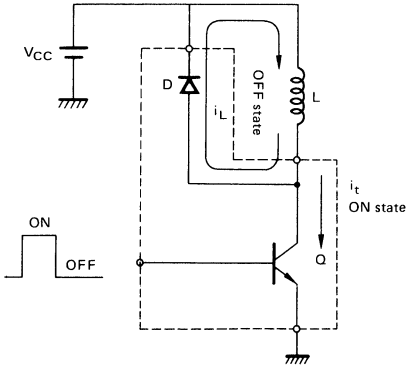
1) General Discription

In solenoid drive applicatins and motor drive applications, the fly-back voltage is generated at the mode of a transistor inductive turn-off.
The darlington transistor array series (FT5753M, FT5754M, FT5755M, FT5763M, FT5764M) can easily absorb the fly-back energy through the fast recovery diodes with the flywheel diode connected between the collector and emitter of the Darlington pair. This guarantees the arrays a very efficient operation.

- Flyback energy absorption circuit

Fig. 1 shows the equivalent drive circuit for a single device of the DLTARY.
During the turn-on mode of the darlington transistor (Q), the current (it) flows through the inductive load (L).
During the turn-off of the darlington transistor (Q), the fly-back energy which is stored in the inductive load (L) is absorbed by current (i_L) which flows through the fast recovery diode.

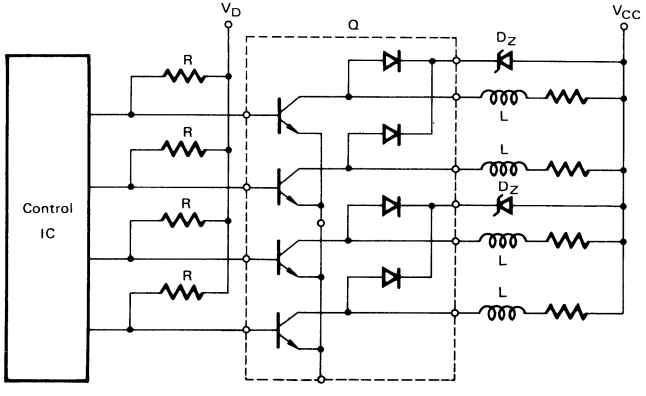
Fig. 1—Circuit for absorbing fly-back energy



2) Solenoid drive circuit

Four solenoids can be driven by one DLTARY.

Fig. 2—Solenoid drive circuit



Q : DLTARY
L : Solenoid
D_Z : Speed-up zener diode
R : Drive current limiting resistance
V_{CC} : Collector supply voltage
V_D : Drive voltage

3) Motor Drive

3–1) Driving form (ex. 4-phase motor)

Motors may be driven in either a unipolar or (Fig.-3(a)) bipolar manner (Fig.-3(b)). The current in uni-polar mode flows in only one direction while the current in bi-polar mode flows in both directions.

Fig. 3–(a) Uni-polar driving form
* Easy Construction

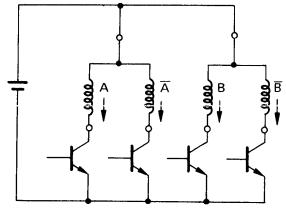
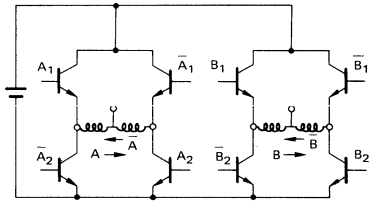
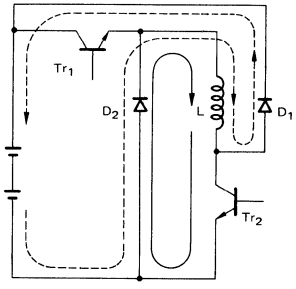


Fig. 3–(b) Bipolar driving form
* Large Output Torque



3–2) Principle circuit for pulse width modulate drive

Fig. 4– Principle circuit for pulse width modulate drive



The output current is controlled by the pulse width of modulator transistor (Tr_1), when the PWM transistor (Tr_1) is in the off-state and the darlington transistor (Tr_2) is in the on-state, the current flows through the fast recovery diode (D_2). (Solid line)
In this mode the fast recovery diode operates similarly to a flywheel diode.
When both the PWM transistor (Tr_1) and darlington transistor are in the off-state current flows through the flywheel diode. (Dashed line)
In this mode, the current flows back to the DC power supply to improve the operating efficiency.

Example of Pulse Width Modulate Drive

January 1990
Edition 1.1

FUJITSU

PRODUCT PROFILE

FT5764M, FT5767M

Silicon Darlington Transistor Array

ABSOLUTE MAXIMUM RATINGS

(Ta = 25°C)

Rating		Symbol	Condition	Value	Unit
Storage Temperature		T_{stg}		−55 ~ +150	°C
Junction Temperature		T_j		+150	°C
Collector to Base Voltage		V_{CBO}		150	V
Emitter to Base Voltage		V_{EBO}		5	V
Collector to Emitter Voltage		V_{CEO}		100	V
Collector Current	(Continuous)	I_C		±3	A
	(Pulsed)	I_{cp}	$P_W \leqq 1$ ms, D.R. $\leqq$ 30%	±5	A
Base Current (Continuous)		I_B		0.2	A
Diode Forward Current		I_{FM}	$P_W \leqq 0.5$ ms, D.R. $\leqq$ 15% (*)	3	A
		I_{FSM}	$P_W \leqq 100$ ms, Single Pulse (*)	5	A
Diode Reverse Voltage		V_R	Pin 3 – Pin 2, 4. Pin 10 – Pin 9, 11 (*)	110	V
Collector Power Dissipation		P_C	Ta = 25°C: Single DLT operation	1.7	W
Total Collector Power Dissipation		P_T	Ta = 25°C: 4-DLT operation	4	W
Total Collector Power Dissipation		P_T	Tc = 25°C: 4-DLT operation	19	W

(*) Fast recovery Diode DLT: Darlington Transistor

ELECTRICAL CHARACTERISTICS

Single Darlington Transistor Operation

(Ta = 25°C)

Parameter	Symbol	Test Condition	Limit			Unit
			Min.	Typ.	Max.	
Collector to Base Breakdown Voltage	$V_{(BR)CBO}$	I_C = 100 μA, I_E = 0	150	–	–	V
Emitter to Base Breakdown Voltage	$V_{(BR)EBO}$	I_E = 70 mA, I_C = 0	5	–	–	V
Collector to Emitter Breakdown Voltage	$V_{(BR)CEO}$	I_C = 10 mA, R_{BE} = ∞	100	–	–	V
Collector Cutoff Current	I_{CBO}	V_{CB} = 100 V, I_E = 0	–	–	10	μA
DC Current Gain	h_{FE1}	I_C = 1.5 A, V_{CE} = 5 V (**)	2000	6000	15000	–
	h_{FE2}	I_C = 3.0 A, V_{CE} = 5 V (**)	500	–	–	–
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	I_C = 1.5 A, I_B = 3 mA (**)	–	1.2	1.5	V
Base to Emitter Saturation Votage	$V_{BE(sat)}$		–	1.7	2.0	V
Turn-On Time	t_{on}	V_{CC} = 30 V (***)	–	0.6	–	μs
Storage Time	t_{stg}	I_C = 1.5 A	–	1.8	–	μs
Fall Time	t_f	$I_{B1} = -I_{B2}$ = 3 mA	–	0.6	–	μs

Single Fast Recovery Diode Operation (FT5764M Only)

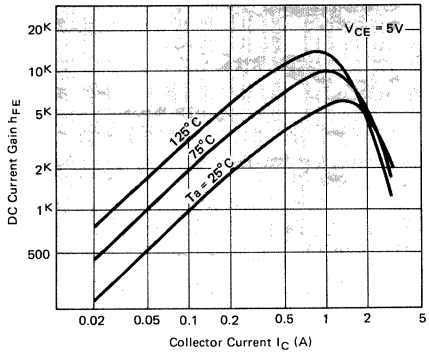
(Ta = 25°C)

Parameter	Symbol	Test Condition	Limit			Unit
			Min.	Typ.	Max.	
Forward Voltage	V_F	I_F = 100 mA	–	–	1.0	V
Reverse Current	I_R	V_R = 100 V	–	–	5	μA
Reverse Voltage	V_R	I_R = 10 μA	110	–	–	V

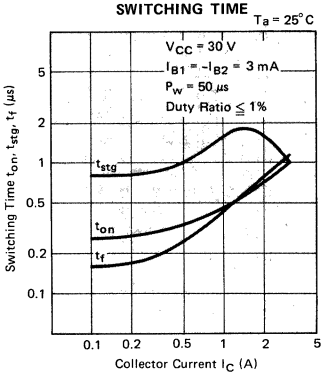
(**) Pulsed Pulse Width $\leqq$ 300 μs Duty Ratio $\leqq$ 6%

(***) Pulsed Pulse Width = 50 μs Duty Ratio $\leqq$ 1%

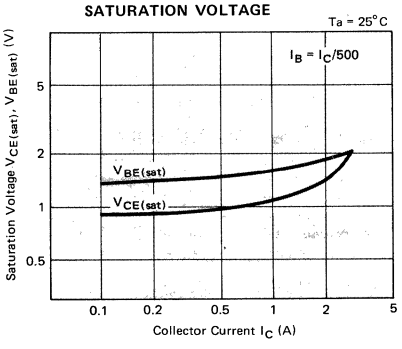
DC CURRENT GAIN



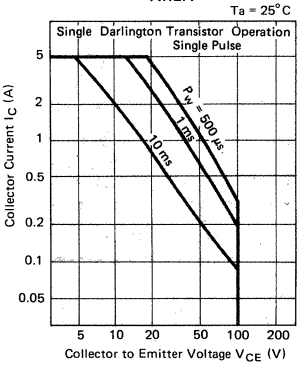
SWITCHING TIME



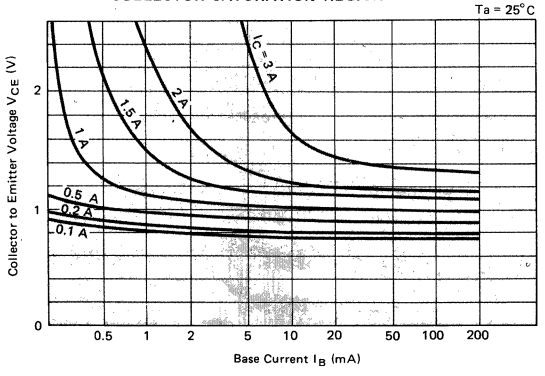
SATURATION VOLTAGE



FORWARD BIAS SAFE OPERATING AREA



COLLECTOR SATURATION REGION



POWER DISSIPATION DERATING