



Integrated Device Technology, Inc.

FAST CMOS OCTAL D FLIP-FLOP WITH CLOCK ENABLE

IDT54/74FCT377T/AT/CT/DT

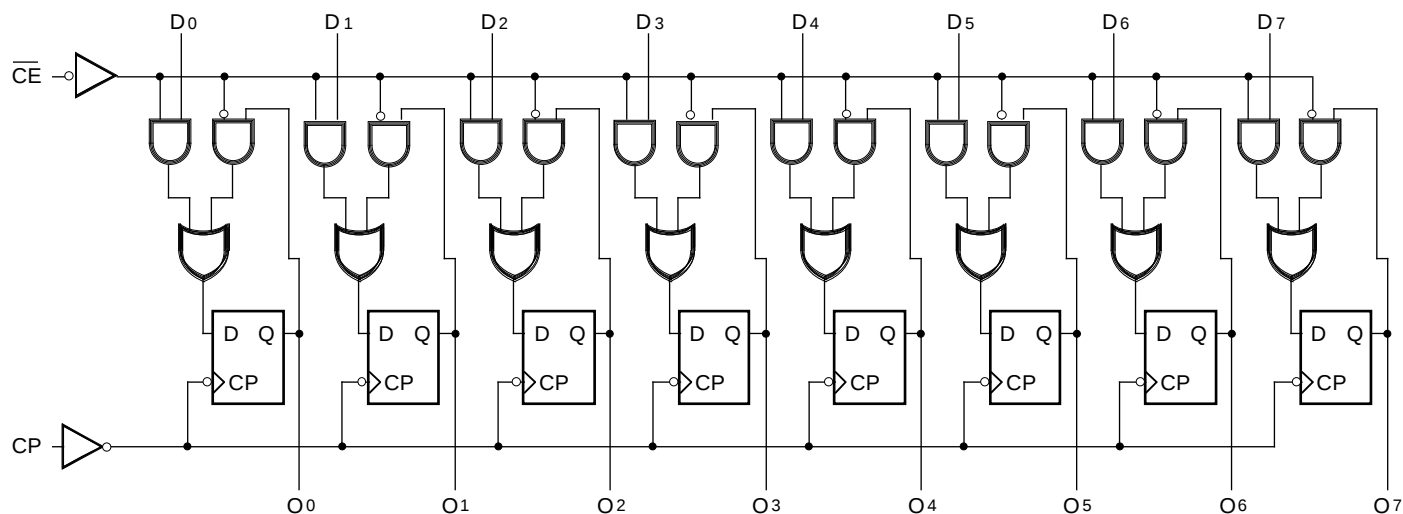
FEATURES:

- Std., A, C and D speed grades
- Low input and output leakage $\leq 1\mu\text{A}$ (max.)
- CMOS power levels
- True TTL input and output compatibility
 - $V_{OH} = 3.3\text{V}$ (typ.)
 - $V_{OL} = 0.3\text{V}$ (typ.)
- High drive outputs (-15mA I_{OH} , 48mA I_{OL})
- Power off disable outputs permit "live insertion"
- Meets or exceeds JEDEC standard 18 specifications
- Product available in Radiation Tolerant and Radiation Enhanced versions
- Military product compliant to MIL-STD-883, Class B and DESC listed (dual marked)
- Available in DIP, SOIC, QSOP, CERPACK and LCC packages

DESCRIPTION:

The IDT54/74FCT377T/AT/CT/DT are octal D flip-flops built using an advanced dual metal CMOS technology. The IDT54/74FCT377T/AT/CT/DT have eight edge-triggered, D-type flip-flops with individual D inputs and O outputs. The common buffered Clock (CP) input loads all flip-flops simultaneously when the Clock Enable ($\overline{CE}$) is LOW. The register is fully edge-triggered. The state of each D input, one set-up time before the LOW-to-HIGH clock transition, is transferred to the corresponding flip-flop's O output. The $\overline{CE}$ input must be stable only one set-up time prior to the LOW-to-HIGH transition for predictable operation.

FUNCTIONAL BLOCK DIAGRAM



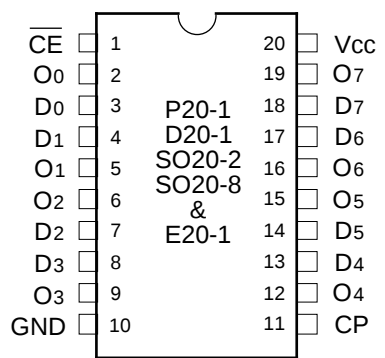
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MILITARY AND COMMERCIAL TEMPERATURE RANGES

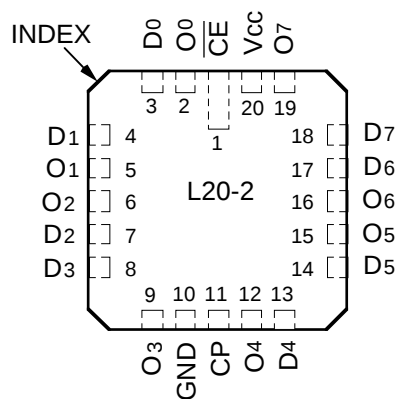
APRIL 1995

PIN CONFIGURATIONS



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**DIP/SOIC/QSOP/CERPACK
TOP VIEW**



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**LCC
TOP VIEW**

PIN DESCRIPTION

Pin Names	Description
D0 – D7	Data Inputs
$\overline{CE}$	Clock Enable (Active LOW)
O0 – O7	Data Outputs
CP	Clock Pulse Input

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FUNCTION TABLE⁽¹⁾

Operating Mode	Inputs			Outputs
	CP	$\overline{CE}$	D	O
Load "1"	↑	l	h	H
Load "0"	↑	l	l	L
Hold	↑ H	h H	X X	No Change No Change

NOTE:

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- H = HIGH Voltage Level
h = HIGH Voltage Level one setup time prior to the LOW-to-HIGH Clock Transition
L = LOW Voltage Level
l = LOW Voltage Level one setup time prior to the LOW-to-HIGH Clock Transition
X = Don't Care
↑ = LOW-to-HIGH Clock Transition

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

Symbol	Rating	Commercial	Military	Unit
VTERM ⁽²⁾	Terminal Voltage with Respect to GND	–0.5 to +7.0	–0.5 to +7.0	V
VTERM ⁽³⁾	Terminal Voltage with Respect to GND	–0.5 to VCC + 0.5	–0.5 to VCC + 0.5	V
TA	Operating Temperature	0 to +70	–55 to +125	°C
TBIAS	Temperature Under Bias	–55 to +125	–65 to +135	°C
TSTG	Storage Temperature	–55 to +125	–65 to +150	°C
PT	Power Dissipation	0.5	0.5	W
IOUT	DC Output Current	–60 to +120	–60 to +120	mA

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NOTES:

- Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability. No terminal voltage may exceed Vcc by +0.5V unless otherwise noted.
- Input and Vcc terminals only.
- Outputs and I/O terminals only.

CAPACITANCE (TA = +25°C, f = 1.0MHz)

Symbol	Parameter ⁽¹⁾	Conditions	Typ.	Max.	Unit
CIN	Input Capacitance	VIN = 0V	6	10	pF
COUT	Output Capacitance	VOUT = 0V	8	12	pF

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NOTE:

- This parameter is measured at characterization but not tested.

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Commercial: $T_A = 0^{\circ}\text{C}$ to $+70^{\circ}\text{C}$, $V_{CC} = 5.0\text{V} \pm 5\%$; Military: $T_A = -55^{\circ}\text{C}$ to $+125^{\circ}\text{C}$, $V_{CC} = 5.0\text{V} \pm 10\%$

Symbol	Parameter	Test Conditions ⁽¹⁾		Min.	Typ. ⁽²⁾	Max.	Unit
V_{IH}	Input HIGH Level	Guaranteed Logic HIGH Level		2.0	—	—	V
V_{IL}	Input LOW Level	Guaranteed Logic LOW Level		—	—	0.8	V
I_{IH}	Input HIGH Current ⁽⁴⁾	$V_{CC} = \text{Max.}$	$V_I = 2.7\text{V}$	—	—	± 1	μA
I_{IL}	Input LOW Current ⁽⁴⁾	$V_{CC} = \text{Max.}$	$V_I = 0.5\text{V}$	—	—	± 1	μA
I_I	Input HIGH Current ⁽⁴⁾	$V_{CC} = \text{Max.}$, $V_I = V_{CC} (\text{Max.})$		—	—	± 1	μA
V_{IK}	Clamp Diode Voltage	$V_{CC} = \text{Min.}$, $I_N = -18\text{mA}$		—	-0.7	-1.2	V
I_{OS}	Short Circuit Current	$V_{CC} = \text{Max.}$ ⁽³⁾ , $V_O = \text{GND}$		-60	-120	-225	mA
V_{OH}	Output HIGH Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -6\text{mA MIL.}$ $I_{OH} = -8\text{mA COM'L.}$	2.4	3.3	—	V
			$I_{OH} = -12\text{mA MIL.}$ $I_{OH} = -15\text{mA COM'L.}$	2.0	3.0	—	V
V_{OL}	Output LOW Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 32\text{mA MIL.}$ $I_{OL} = 48\text{mA COM'L.}$	—	0.3	0.5	V
I_{OFF}	Input/Output Power Off Leakage ⁽⁵⁾	$V_{CC} = 0\text{V}$, V_{IN} or $V_O \leq 4.5\text{V}$		—	—	± 1	μA
V_H	Input Hysteresis	—		—	200	—	mV
I_{CC}	Quiescent Power Supply Current	$V_{CC} = \text{Max.}$ $V_{IN} = \text{GND}$ or V_{CC}		—	0.01	1	mA

NOTES:

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- For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at $V_{CC} = 5.0\text{V}$, $+25^{\circ}\text{C}$ ambient.
- Not more than one output should be shorted at one time. Duration of the short circuit test should not exceed one second.
- The test limit for this parameter is $\pm 5\mu\text{A}$ at $T_A = -55^{\circ}\text{C}$.
- This parameter is guaranteed but not tested.

POWER SUPPLY CHARACTERISTICS

Symbol	Parameter	Test Conditions ⁽¹⁾		Min.	Typ. ⁽²⁾	Max.	Unit
ΔI_{CC}	Quiescent Power Supply Current TTL Inputs HIGH	$V_{CC} = \text{Max.}$ $V_{IN} = 3.4V^{(3)}$		—	0.5	2.0	mA
I_{CCD}	Dynamic Power Supply Current ⁽⁴⁾	$V_{CC} = \text{Max.}$, Outputs Open $\overline{CE} = \text{GND}$ One Input Toggling 50% Duty Cycle	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	0.15	0.25	mA/ MHz
I_C	Total Power Supply Current ⁽⁶⁾	$V_{CC} = \text{Max.}$, Outputs Open $f_{CP} = 10\text{MHz}$ $\overline{CE} = \text{GND}$ One Bit Toggling $f_i = 5\text{MHz}$ 50% Duty Cycle	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	1.5	3.5	mA
			$V_{IN} = 3.4V$ $V_{IN} = \text{GND}$	—	2.0	5.5	
		$V_{CC} = \text{Max.}$, Outputs Open $f_{CP} = 10\text{MHz}$, 50% Duty Cycle $\overline{CE} = \text{GND}$ Eight Bits Toggling $f_i = 2.5\text{MHz}$ 50% Duty Cycle	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	3.8	7.3 ⁽⁵⁾	
			$V_{IN} = 3.4V$ $V_{IN} = \text{GND}$	—	6.0	16.3 ⁽⁵⁾	

NOTES:

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- For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at $V_{CC} = 5.0V$, $+25^\circ\text{C}$ ambient.
- Per TTL driven input ($V_{IN} = 3.4V$). All other inputs at V_{CC} or GND .
- This parameter is not directly testable, but is derived for use in Total Power Supply Calculations.
- Values for these conditions are examples of the I_{CC} formula. These limits are guaranteed but not tested.
- $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$
 $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP}/2 + f_i N_i)$
 I_{CC} = Quiescent Current
 ΔI_{CC} = Power Supply Current for a TTL High Input ($V_{IN} = 3.4V$)
 D_H = Duty Cycle for TTL Inputs High
 N_T = Number of TTL Inputs at D_H
 I_{CCD} = Dynamic Current Caused by an Input Transition Pair (HLH or LHL)
 f_{CP} = Clock Frequency for Register Devices (Zero for Non-Register Devices)
 f_i = Input Frequency
 N_i = Number of Inputs at f_i
All currents are in milliamps and all frequencies are in megahertz.

SWITCHING CHARACTERISTICS OVER OPERATING RANGE

Symbol	Parameter	Condition ⁽¹⁾	IDT54/74FCT377T				FCT54/74FCT377AT				Unit
			Com'l.		Mil.		Com'l.		Mil.		
			Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	
tPLH tPHL	Propagation Delay CP to On	CL = 50pF RL = 500Ω	2.0	13.0	2.0	15.0	2.0	7.2	2.0	8.3	ns
tsu	Set-Up Time HIGH or LOW Dn to CP		2.5	—	3.0	—	2.0	—	2.0	—	ns
tH	Hold Time HIGH or LOW Dn to CP		2.0	—	2.5	—	1.5	—	1.5	—	ns
tsu	Set-Up Time HIGH or LOW CE to CP		4.0	—	4.0	—	3.5	—	3.5	—	ns
tH	Hold Time HIGH or LOW CE to CP		1.5	—	1.5	—	1.5	—	1.5	—	ns
tw	Clock Pulse Width, HIGH or LOW		7.0	—	7.0	—	6.0	—	7.0	—	ns

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Symbol	Parameter	Condition ⁽¹⁾	IDT54/74FCT377CT				FCT54/74FCT377DT				Unit
			Com'l.		Mil.		Com'l.		Mil.		
			Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	Min. ⁽²⁾	Max.	
tPLH tPHL	Propagation Delay CP to On	CL = 50pF RL = 500Ω	2.0	5.2	2.0	5.5	2.0	4.4	—	—	ns
tsu	Set-Up Time HIGH or LOW Dn to CP		2.0	—	2.0	—	2.0	—	—	—	ns
tH	Hold Time HIGH or LOW Dn to CP		1.5	—	1.5	—	1.0	—	—	—	ns
tsu	Set-Up Time HIGH or LOW CE to CP		3.5	—	3.5	—	3.0	—	—	—	ns
tH	Hold Time HIGH or LOW CE to CP		1.5	—	1.5	—	0.0	—	—	—	ns
tw	Clock Pulse Width, HIGH or LOW		6.0	—	7.0	—	3.0	—	—	—	ns

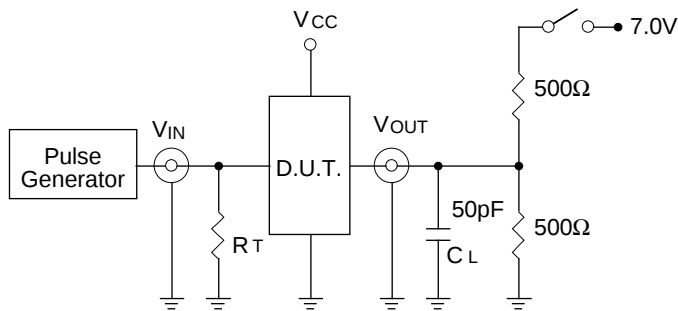
NOTES:

1. See test circuit and waveforms.
2. Minimum limits are guaranteed but not tested on Propagation Delays.

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TEST CIRCUITS AND WAVEFORMS

TEST CIRCUITS FOR ALL OUTPUTS



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SWITCH POSITION

Test	Switch
Open Drain Disable Low Enable Low	Closed
All Other Tests	Open

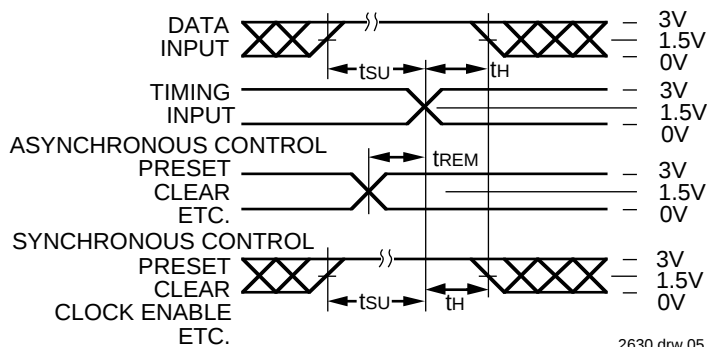
DEFINITIONS:

C_L = Load capacitance: includes jig and probe capacitance.

R_T = Termination resistance: should be equal to Z_{OUT} of the Pulse Generator.

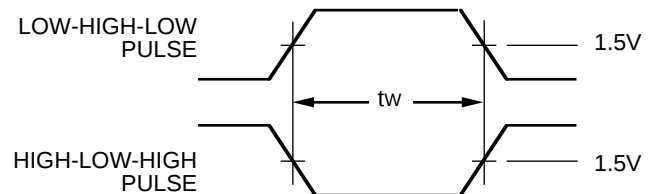
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SET-UP, HOLD AND RELEASE TIMES



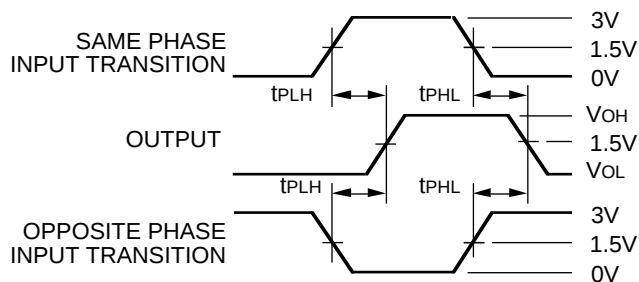
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PULSE WIDTH



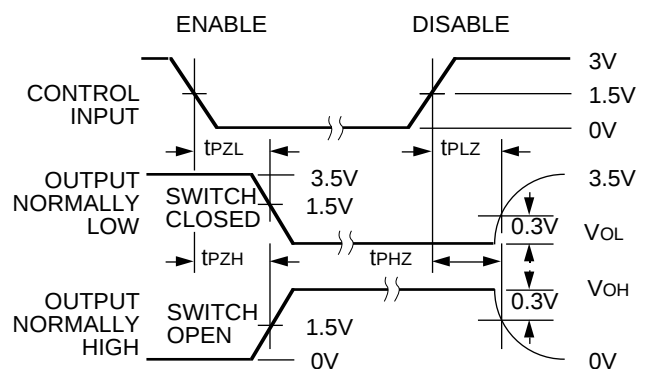
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PROPAGATION DELAY



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ENABLE AND DISABLE TIMES

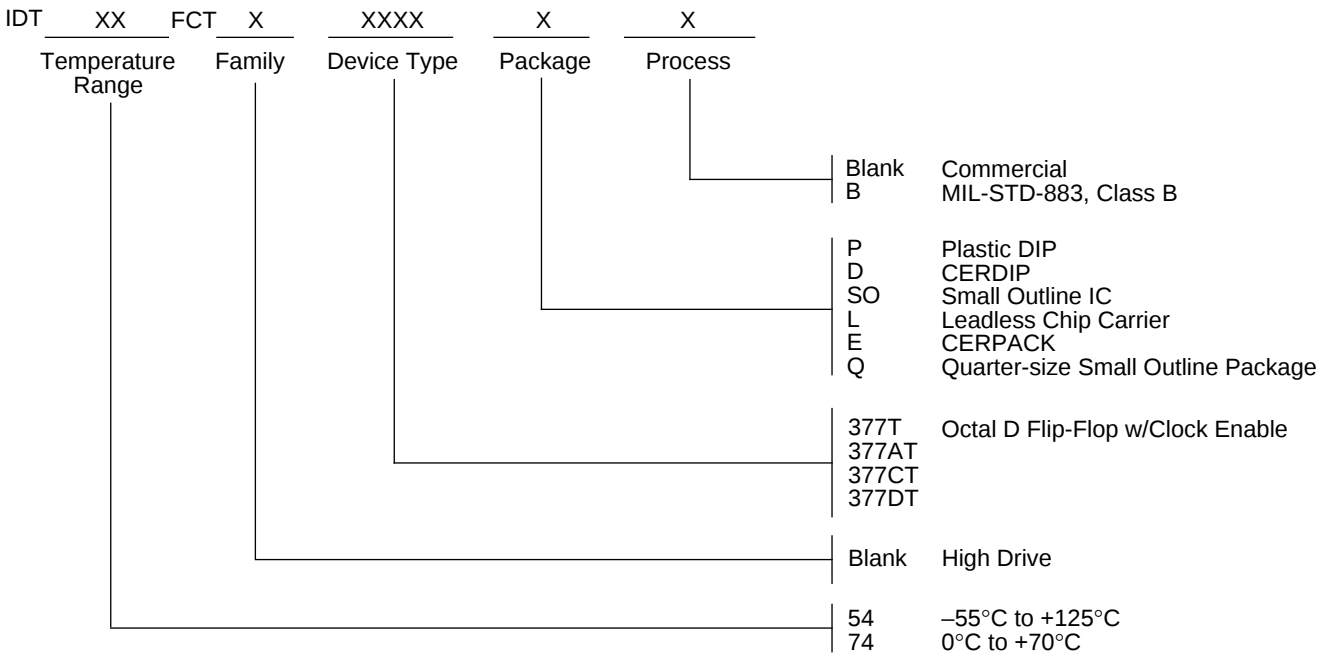


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NOTES:

- Diagram shown for input Control Enable-LOW and input Control Disable-HIGH
- Pulse Generator for All Pulses: Rate $\leq 1.0\text{MHz}$; $t_r \leq 2.5\text{ns}$; $t_f \leq 2.5\text{ns}$

ORDERING INFORMATION



2630 drw 09