

CHAPTER 4

ENGINE ELECTRICAL

Ignition and Alternator Data

1985	4.1
1986	4.2
1987	4.3
1988	4.4
1989	4.5
1990	4.6
1991	4.7
1992	4.8
1993	4.9
1994	4.10
1995	4.11

Ignition Systems

Typical 1985 - Current Timing Advance Curves	4.12
Conversion Chart - Degrees to Piston Position B.T.D.C.	4.13

Timing

Single Cylinder CDI Ignition - Exploded View - Timing	4.14
Twin Cylinder Fan CDI Ignition (Fixed) - Exploded View - Timing	4.15
Twin Cylinder Fan CDI Ignition (Adjustable) - Exploded View - Timing	4.16
Twin Cylinder Liquid CDI Ignition (Pulse, Pulseless) - Exploded View - Timing ..	4.17
Three Cylinder CDI Ignition (Pulse, Trigger) - Exploded View - Timing	4.18
Three Cylinder CDI Ignition (Storm and XLT) - Exploded View - Timing	4.19
Operating RPM Timing Check - All Models	4.20

Ignition System Troubleshooting

Ignition System Testing	4.21
Ignition/Charging System Testing	4.22-4.25

Alternator

Ignition System Troubleshooting	4.26
Alternator Output Test - Open Circuit	4.27
Typical Exciter, Pulser or Lighting Coil Replacement	4.28
Battery Service	4.29-4.30

Electric Starter System

Electric Starter System Testing	4.31
Electric Starter System Testing (Static)	4.32
Electric Starter Reassembly and Reinstallation	4.33

Electronic Fuel Injection

EFI Introduction and Operation	4.35
EFI Data	4.36
Battery Maintenance and Testing	4.37
Power Up Testing	4.38-4.41
Alternator Controlled Switch "ACS"	4.42
Basic Operation - System II	4.43

Fuel Handling System

Tank, Hose and Filters	4.44
Fuel Pump	4.44
Fuel Rail	4.45
Return Hose	4.45
Pressure Regulator	4.45
Injector (Mechanical)	4.46
EFI Fuel System Maintenance and Testing	4.47
Throttle Body	4.48

Electronic Control System

System III - Electronics Operation	4.49-4.50
System III - Electronics Testing	4.51-4.56
Select Monitor/RPM Sensor	4.54
Throttle Position Sensor	4.55
Intake Air Temperature Sensor	4.56
Crankcase Temperature Sensor	4.56
Barometric Pressure Sensor	4.57
MR Adjustments	4.58
Type II System - 1991 to Current EFI's	4.59
Fuel Injectors	4.60
Dropping Resistor	4.60
ECU Diagnostics	4.61
Select Monitor Readings	4.61
Mode Description Chart	4.61
Memory Fail Code Description	4.61
EFI Electronics	4.62
1994-1995 Wiring Diagram, RXL	4.63
1994-1995 Wiring Diagram, 500 EFI	4.64-4.65




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ENGINE ELECTRICAL Ignition Data

1985 Models

Machine Model	Engine Model	Ignition Type Alternator Output	Spark Plug		Plug Gap Inches
			NGK	Champion	
Star	EC25PS-06	CDI-100 Watt	BR8ES	RN-3C	.020
SS	EC44-2PM-3100	CDI-120 Watt	BR9ES	RN-2C	.020
Indy Trail	EC44-2PM-2100	CDI-120 Watt	BR9ES	RN-2C	.020
Indy 400	EC40PL-02	CDI-120 Watt	BR9ES	RN-2C	.020
Indy 600	EC60PL-02	CDI-120 Watt	BR9ES	RN-2C	.020
Long Track	EC44-2PM-5000	CDI-120 Watt	BR9ES	RN-2C	.020

Engine Model	Running Ignition Timing at 3000 RPM					
	MM BTDC	Inches BTDC	Degrees BTDC	Acceptable Variances		
				MM	Inches	Degrees
EC25PS-06	4.19	.165	27.5	3.35-5.12	.132-.202	24.5-30.5
EC44-2PM-3100	3.93	.155	26.5	3.39-4.56	.133-.179	24.5-28.5
EC44-2PM-2100	3.93	.155	26.5	3.39-4.56	.133-.179	24.5-28.5
EC40PL-02	5.19	.204	30.5	4.55-5.85	.179-.230	28.5-32.5
EC60PL-02	4.10	.162	27.0	3.81-4.40	.150-.173	26-28
EC44-2PM-5000	3.93	.155	26.5	3.36-4.56	.133-.179	24.5-28.5

 All above engines require a minimum of 88 (R+M)/2 octane fuel. If fuels of a lesser octane number are used or engines are subjected to frequent overheated situations, the timing must be adjusted to the low side of the accepted variance.

R.F.I. spark plug cap resistance: 3,700 to 6,300 ohms.


ENGINE ELECTRICAL

Ignition Data

1986 Models

Machine Model	Engine Model	Ignition Type Alternator Output	Spark Plug		Plug Gap Inches
			NGK	Champion	
Star	EC25PS-06	CDI-100 Watt	BR8ES	RN-3C	.020
Sprint (ES)	EC34-2PM-01/02	CDI-120 Watt	BR9ES	RN-2C	.020
SS	EC44-2PM-3100	CDI-120 Watt	BR9ES	RN-2C	.020
Indy Trail	EC50PM-01	CDI-120 Watt	BR9ES	RN-2C	.020
Indy 400	EC40PL-02	CDI-120 Watt	BR9ES	RN-2C	.020
Indy 600 (LE)	EC60PL-02	CDI-120 Watt	BR9ES	RN-2C	.020
Long Track	EC44-2PM-5100	CDI-120 Watt	BR9ES	RN-2C	.020

Engine Model	Running Ignition Timing at 3000 RPM					
	MM BTDC	Inches BTDC	Degrees BTDC	Acceptable Variances		
				MM	Inches	Degrees
EC25PS-06	4.19	.165	27.5 ± 3	3.35-5.12	.132-.202	20.5° @ 6000
EC34-2PM-01/02	3.41	.134	25.5 ± 2	2.90-3.94	.114-.160	15.5° @ 7000
EC44-2PM-3100	3.93	.155	26.5 ± 2	3.39-4.56	.133-.179	14.5° @ 6500
EC50PM-01	3.26	.128	24.0 ± 2	2.75-3.53	.108-.150	16° @ 6500
EC40PL-02	5.19	.204	30.5 ± 2	4.55-5.85	.179-.230	15° @ 7500
EC60PL-02	4.10	.162	27.0 ± 1	3.81-4.40	.150-.173	20° @ 7500
EC44-2PM-5100	3.40	.134	24.5 ± 2	2.87-3.93	.113-.155	12.5° @ 6500

 All above engines require a minimum of 88 (R+M)/2 octane fuel. If fuels of a lesser octane number are used or engines are subjected to frequent overheated situations, the timing must be adjusted to the low side of the accepted variance.


R.F.I. spark plug cap resistance: 3,700 to 6,300 ohms.

ENGINE ELECTRICAL Ignition Data

1987 Models

Machine Model	Engine Model	Ignition Type Alternator Output	Spark Plug		Plug Gap Inches
			NGK	Champion	
Star, Star Trak	EC25PS-06	CDI-100 Watt	BR8ES	RN-3C	.025
Sprint (ES)	EC34-2PM-01/02	CDI-120 Watt	BR9ES	RN-2C	.025
Indy Sport	EC34-2PM-03	CDI-120 Watt	BR9ES	RN-2C	.025
Indy Trail (All)	EC50PM-01/02	CDI-120 Watt	BR9ES	RN-2C	.025
Indy 400	EC40PL-02	CDI-120 Watt	BR9ES	RN-2C	.025
Indy 600	EC60PL-02	CDI-120 Watt	BR9ES	RN-2C	.025
Long Track (RLR)	EC44-2PM-5100	CDI-120 Watt	BR9ES	RN-2C	.025

Engine Model	Running Ignition Timing at 3000 RPM					
	MM BTDC	Inches BTDC	Degrees BTDC	Acceptable Variances		
				MM	Inches	Degrees
EC25PS-06	4.19	.165	27.5 ± 3	3.35-5.12	.132-.202	20.5° @ 6000
EC34-2PM-01/02	3.41	.134	25.5 ± 2	2.90-3.94	.114-.160	15.5° @ 7000
EC34-2PM-03	3.41	.134	25.5 ± 2	2.90-3.94	.114-.160	15.5° @ 7000
EC50PM-01/02	3.26	.128	24.0 ± 2	2.75-3.53	.108-.150	16° @ 6500
EC40PL-02	5.19	.204	30.5 ± 2	4.55-5.85	.179-.230	15° @ 7500
EC60PL-02	4.10	.162	27.0 ± 1	3.81-4.40	.150-.173	20° @ 7500
EC44-2PM-5100	3.40	.134	24.5 ± 2	2.87-3.93	.113-.155	12.5° @ 6500

 All above engines require a minimum of 88 (R+M)/2 octane fuel. If fuels of a lesser octane number are used or engines are subjected to frequent overheated situations, the timing must be adjusted to the low side of the accepted variance.

R.F.I. spark plug cap resistance: 3,700 to 6,300 ohms.


ENGINE ELECTRICAL

Ignition Data

1988 Models

Machine Model	Engine Model	Ignition Type Alternator Output	Spark Plug		Plug Gap Inches	CDI Box Identification Number
			NGK	Champion		
Star, Star Trak	EC25PS-06	CDI-100 Watt	BR8ES	RN-3C	.025	CU6204
Sprint (ES)	EC34-2PM-02	CDI-120 Watt	BR9ES	RN-2C	.025	CU6409
Indy Sport	EC34-2PM-03	CDI-120 Watt	BR9ES	RN-2C	.025	CU6409
Indy Trail (All)	EC50PM-01/02	CDI-120 Watt	BR9ES	RN-2C	.025	CU6410
Indy 400 (All)	EC40PL-02/03	CDI-120 Watt	BR9ES	RN-2C	.025	CU6408
Indy 650	EC65PL-01	CDI-120 Watt	BR9ES	RN-2C	.025	CU1559
Long Trak (RLR)	EC44-2PM-4100	CDI-120 Watt	BR9ES	RN-2C	.025	CU6405

Engine Model	Running Ignition Timing at 3000 RPM					
	MM BTDC	Inches BTDC	Degrees BTDC	Acceptable Variances		
				MM	Inches	Degrees
EC25PS-06	4.19	.165	27.5 ± 3	3.35-5.12	.132-.202	20.5° @ 6000
EC34-2PM-02	3.41	.134	25.5 ± 2	2.90-3.94	.114-.160	15.5° @ 7000
EC34-2PM-03	3.41	.134	25.5 ± 2	2.90-3.94	.114-.160	15.5° @ 7000
EC50PM-01/02	3.26	.128	24.0 ± 2	2.75-3.53	.108-.150	16° @ 6500
EC40PL-02/03	5.19	.204	30.5 ± 2	4.55-5.85	.179-.230	15° @ 7500
EC65PL-01	4.10	.162	27.0 ± 1	3.81-4.40	.150-.173	20° @ 7500
EC44-2PM-4100	3.76	.148	26.5 ± 2	3.23-4.29	.127-.169	14.5° @ 6500

 All above engines require a minimum of 88 (R+M)/2 octane fuel. If fuels of a lesser octane number are used or engines are subjected to frequent overheated situations, the timing must be adjusted to the low side of the accepted variance.


R.F.I. spark plug cap resistance: 3,700 to 6,300 ohms.

ENGINE ELECTRICAL Ignition Data

1989 Models

Machine Model	Engine Model	Ignition Type Alternator Output	Spark Plug		Plug Gap Inches	CDI Box Identification Number
			NGK	Champion		
Star, Star Trak	EC25PS-06	CDI-100 Watt	BR8ES	RN-3C	.025	CU6204
Sprint (ES)	EC34-2PM-02	CDI-120 Watt	BR9ES	RN-2C	.025	CU6409
Indy Sport	EC34-2PM-03	CDI-120 Watt	BR9ES	RN-2C	.025	CU6409
Indy Trail (All)	EC50PM-01/02/03	CDI-120 Watt	BR9ES	RN-2C	.025	CU6410
Indy 400 (All)	EC40PL-02	CDI-120 Watt	BR9ES	RN-2C	.025	CU6408
Indy 500 (All)	EC50PL-01/02	CDI-120 Watt	BR9ES	RN-2C	.025	CU6408
Indy 650	EC65PL-01	CDI-120 Watt	BR9ES	RN-2C	.025	CU1559
Long Trak (RLR)	EC44-2PM-4100	CDI-120 Watt	BR9ES	RN-2C	.025	CU6405

Engine Model	Running Ignition Timing at 3000 RPM					
	MM BTDC	Inches BTDC	Degrees BTDC	Acceptable Variances		
				MM	Inches	Degrees
EC25PS-06	4.19	.165	27.5 ± 3	3.35-5.12	.132-.202	20.5° @ 6000
EC34-2PM-02	3.41	.134	25.5 ± 2	2.90-3.94	.114-.160	15.5° @ 7000
EC34-2PM-03	3.41	.134	25.5 ± 2	2.90-3.94	.114-.160	15.5° @ 7000
EC50PM-01/02	3.26	.128	24.0 ± 2	2.75-3.53	.108-.150	16° @ 6500
EC50PM-03	5.03	.198	30.0 ± 2	4.40-5.69	.173-.224	22° @ 6500
EC40PL-02	5.19	.204	30.5 ± 2	4.55-5.85	.179-.230	15° @ 7500
EC50PL-01/02	5.19	.204	30.5 ± 2	4.55-5.85	.179-.230	15° @ 7500
EC65PL-01	4.10	.162	27.0 ± 1	3.81-4.40	.150-.173	20° @ 7500
EC44-2PM-4100	3.76	.148	26.5 ± 2	3.23-4.29	.127-.169	14.5° @ 6500

 All above engines require a minimum of 88 (R+M)/2 octane fuel. If fuels of a lesser octane number are used or engines are subjected to frequent overheated situations, the timing must be adjusted to the low side of the accepted variance.

R.F.I. spark plug cap resistance: 3,700 to 6,300 ohms.

ENGINE ELECTRICAL

Ignition Data

1990 Models

Machine Model	Engine Model	Ignition Type Alternator Output	Spark Plug		Plug Gap Inches	CDI Box Identification Number
			NGK	Champion		
Star, Star Trak	EC25PS-06	CDI-150 Watt	BR8ES	RN-3C	.025	CU2167
Sprint (ES)	EC34-2PM-02	CDI-150 Watt	BR9ES	RN-2C	.025	CU6409
Indy Sport	EC34-2PM-03	CDI-150 Watt	BR9ES	RN-2C	.025	CU6409
Indy Trail (All)	EC50PM-01/02/03	CDI-200 Watt	BR9ES	RN-2C	.025	CU6413
Indy 400	EC40PL-02	CDI-200 Watt	BR8ES	RN-3C	.025	CU6412
Indy 500 (All) Incl. WideTrak	EC50PL-01/02/03	CDI-200 Watt	BR8ES	RN-3C	.025	CU6412
Indy 650 RXL	EC65PL-01 -03	CDI-120 Watt -180 Watt	BR9ES	RN-2C	.025	CU1559 CU2178

Engine Model	Running Ignition Timing at 3000 RPM					
	MM BTDC	Inches BTDC	Degrees BTDC	Acceptable Variances		
				MM	Inches	Degrees
EC25PS-06	4.19	.165	27.5 ± 3	3.35-5.12	.132-.202	20.5° @ 6000
EC34-2PM-02	3.41	.134	25.5 ± 2	2.90-3.94	.114-.160	15.5° @ 7000
EC34-2PM-03	3.41	.134	25.5 ± 2	2.90-3.94	.114-.160	15.5° @ 7000
EC50PM-01/02	3.26	.128	24.0 ± 2	2.75-3.53	.108-.150	16° @ 6500
EC50PM-03	4.71	.185	29.0 ± 2	4.10-5.35	.162-.210	21° @ 6500
EC40PL-02	5.36	.210	31.0 ± 2	4.71-6.04	.185-.238	15° @ 7500
EC50PL-01/02	5.36	.210	31.0 ± 2	4.71-6.04	.185-.238	15° @ 7500
EC50PL-03	5.36	.210	31.0 ± 2	4.71-6.04	.185-.238	15.5° @ 7000
EC65PL-01	4.10	.162	27.0 ± 1	3.81-4.40	.150-.173	20° @ 7500
EC65PL-03	5.02	.198	30.0 ± 1	1.65-2.06	.065-.081	18° @ 7500

ENGINE ELECTRICAL Ignition Data

1991 Models

Machine Model	Engine Model	Ignition Type Alternator Output	Spark Plug		Plug Gap MM/Inches	CDI Box Identification Number
			NGK	Champion		
StarLite	EC25PS-07	CDI-150 Watt	BR8ES	RN-3C	0.7/028	CU6204
Indy Lite	EC34-2PM-03	CDI-150 Watt	BR8ES	RN-2C	0.7/028	CU6409
Indy Sport/GT	EC44-3PM-01	CDI-200 Watt	BR8ES	RN-2C	0.7/028	CU6416
Indy Trail (All)	EC50PM-01/02/03	CDI-200 Watt	BR8ES	RN-2C	0.7/028	CU6413
Indy 400	EC40PL-02 EC40PL-04	CDI-200 Watt	BR8ES	RN-3C	0.7/028	CU6412 CU6415
Indy 500 (All) Incl. WideTrak	EC50PL-01/02/03 EC50PL-04/05/06	CDI-200 Watt	BR8ES	RN-3C	0.7/028	CU6412 CU6415
Indy 650/RXL	EC65PL-02/03	CDI-180 Watt	BR9ES	RN-2C	0.7/028	CU2178

Engine Model	Running Ignition Timing at 3000 RPM					
	MM BTDC	Inches BTDC	Degrees BTDC	Acceptable Variances		
				MM	Inches	Degrees
EC25PS-07	4.19	.165	27.5 ± 3	3.35-5.12	.132-.202	20.5° @ 6000
EC34-2PM-03	3.41	.134	25.5 ± 2	2.90-3.94	.114-.155	16° @ 7000
EC44-3PM-01	3.26	.128	24.0 ± 2	2.75-3.811	.108-.150	16° @ 6500
EC50PM-01/02	3.26	.128	24.0 ± 2	2.75-3.811	.108-.150	16° @ 6500
EC50PM-03	4.71	.185	29.0 ± 2	4.10-5.35	.162-.210	21° @ 6500
EC40PL-02 -04	5.36 3.93	.210 .155	31.0 ± 2 26.5 ± 2	4.71-6.04 3.40-4.55	.185-.238 .133-.179	16° @ 7500
EC50PL-01/02 -04/05	5.36 3.96	.210 .155	31.0 ± 2 26.5 ± 2	4.71-6.04 3.40-4.55	.185-.238 .133-.179	16° @ 7500
EC50PL-06	3.96	.155	26.5 ± 2	3.40-4.55	.133-.179	16° @ 7500
EC65PL-02/03	3.26	.128	24.0 ± 1	3.00-3.53	.118-.139	18° @ 7500

ENGINE ELECTRICAL

Ignition Data

1992 Models

Machine Model	Engine Model	Ignition Type Alternator Output	Spark Plug		Plug Gap MM/Inches	CDI Box Identification Number
			NGK	Champion		
StarLite	EC25PS-07	CDI-150 Watt	BR8ES*	RN-3C	0.7/028	CU6204
Indy Lite/GT/DLX	EC34-2PM-02/03/04	CDI-150 Watt	BR8ES*	RN-3C	0.7/028	CU6409
Indy Sport/GT	EC44-3PM-01	CDI-200 Watt	BR8ES*	RN-3C	0.7/028	CU6416
Indy Trail (All)	EC50PM-01/02/03	CDI-200 Watt	BR8ES*	RN-3C	0.7/028	CU6413
Indy 440 Indy XCR	EC45PL-02 EC45PL-01	CDI-200 Watt	BR8ES BR9ES	RN-3C* RN-2C*	0.7/028	CU6415
Indy 500, Classic WideTrak, 500SP	EC50PL-04/05/ 06/07	CDI-200 Watt	BR8ES	RN-3C*	0.7/028	CU6415
Indy 650, RXL	EC65PL-02/03	CDI-180 Watt	BR9ES	RN-2C*	0.7/028	CU2178

* Original Equipment

Engine Model	Running Ignition Timing at 3000 RPM					
	MM BTDC	Inches BTDC	Degrees BTDC	Acceptable Variances		
				MM	Inches	Degrees
EC25PS-07	4.05	.159	27 ± 3	3.22-4.96	.127-.195	20.5° @ 6000
EC34-2PM-02/03/04	3.28	.129	25 ± 1.5	2.90-3.67	.114-.144	16° @ 7000
EC44-3PM-01	3.81	.150	26 ± 1.5	3.39-4.25	.133-.167	16° @ 6500
EC50PM-01/02	3.81	.150	26 ± 1.5	3.39-4.25	.133-.167	16° @ 6500
EC50PM-03	4.71	.185	29 ± 1.5	4.25-5.20	.167-.204	19° @ 6500
EC45PL-02/01	4.40	.173	28 ± 1.5	3.91-4.87	.156-.191	16° @ 7500
EC50PL-04/05/06	4.40	.173	28 ± 1.5	3.91-4.87	.156-.191	16° @ 7500
EC50PL-07	4.71	.185	29 ± 1.5	4.25-5.20	.167-.204	17° @ 7500
EC65PL-02 -03	3.26 3.53	.128 .139	24 ± 1.5 25 ± 1.5	2.87-3.67 3.13-4.01	.113-.144 .123-.156	18° @ 7500 19° @ 7500

ENGINE ELECTRICAL Ignition Data

1993 Models

Machine Model	Engine Model	Ignition Type Alternator Output	Spark Plug		Plug Gap MM/Inches	CDI Box Identification Number
			NGK	Champion		
StarLite/GT	EC25PS-07	CDI-150 Watt	BR8ES*	RN-3C	0.7/.028	CU6204
IndyLite/GT/DLX	EC34-2PM-02/04	CDI-150 Watt	BR8ES*	RN-3C	0.7/.028	CU6409
Indy Sport/GT	EC44-3PM-01	CDI-200 Watt	BR8ES*	RN-3C	0.7/.028	CU6416
Indy Trail (All)	EC50PM-01	CDI-200 Watt	BR8ES*	RN-3C	0.7/.028	CU6413
Indy 440 Indy XCR	EC45PL-02 EC45PL-01	CDI-200 Watt	BR8ES BR9ES	RN-3C* RN-2C*	0.7/.028	CU6415
Classic WideTrak 500 EFI	EC50PL-04 05/06/07	CDI-200 Watt	BR8ES	RN-3C*	0.7/.028	CU6415
XLT (All)	EC58PL-01	CDI-170 Watt	BR9ES	RN-2C*	0.7/.028	CU2194
Indy RXL	EC65PL-05	CDI-180 Watt	BR9ES	RN-2C*	0.7/.028	CU2178
Indy Storm	EC75PL-01	CDI-170 Watt	BR9ES*	RN-2C	0.7/.028	CU2196

* Original Equipment

Running Ignition Timing at 3000 RPM						Operating Timing and RPM
Engine Model	MM BTDC	Inches BTDC	Degrees BTDC	Acceptable Variances		
				MM	Inches	
EC25PS-07	4.05	.159	27±3	3.22-4.96	.127-.195	20.5° @ 6000
EC34-2PM-02/04	3.28	.129	25±1.5	2.90-3.67	.114-.144	16° @ 7000
EC44-3PM-01	3.81	.150	26±1.5	3.39-4.25	.133-.167	16° @ 6500
EC50PM-01	3.81	.150	26±1.5	3.39-4.25	.133-.167	16° @ 6500
EC45PL-01/02	4.40	.173	28±1.5	3.91-4.87	.156-.191	16° @ 7500
EC50PL-04/05/06	4.40	.173	28±1.5	3.91-4.87	.156-.191	16° @ 7500
EC50PL-07	4.71	.185	29±1.5	4.25-5.20	.167-.204	17° @ 7500
EC58PL-01	4.40	.173	28±1.5	3.91-4.87	.156-.191	20° @ 7500
EC65PL-05	3.53	.139	25±1.5	3.13-4.01	.123-.156	19° @ 7500
EC75PL-01	4.74	.187	28±1.5	4.30-5.28	.168-.206	12° @ 8000

ENGINE ELECTRICAL

Ignition Data

1994 Models

Machine Model	Engine Model	Ignition Type Alternator Output	Spark Plug		Plug Gap MM/inches	CDI Box Identification Number	Fly- wheel ID #
			NGK	Champion			
StarLite/GT	EC25PS-07	CDI-150 Watt	BR8ES*	RN-3C	0.7/.028	CU6204	FP5355
IndyLite/GT/DLX	EC34-2PM-02/04	CDI-150 Watt	BR8ES*	RN-3C	0.7/.028	CU6409	FP5439
Indy Sport/Super Sport	EC44-3PM-01	CDI-200 Watt	BR8ES*	RN-3C	0.7/.028	CU6416	FP5446
Indy Trail (All) WideTrak GT	EC50PM-01/02/03	CDI-200 Watt	BR8ES*	RN-3C	0.7/.028	CU6413	FP5441
Indy 440 Indy XCR	EC45PL-02 EC45PL-01	CDI-200 Watt	BR8ES BR9ES	RN-3C* RN-2C*	0.7/.028	CU6415	FP5445
Classic WideTrak 500 EFI	EC50PL-05/06/07/08	CDI-200 Watt 05/06 CDI 250 Watt 07/08	BR8ES	RN-3C*	0.7/.028	CU6415	FP5445
XLT (All)	EC58PL-01	CDI-170 Watt	BR8ES	RN-3C*	0.7/.028	CU2194	FP8312
Indy RXL	EC65PL-05/06	CDI-180 Watt	BR9ES	RN-2C*	0.7/.028	CU2178	FP6392
Indy Storm	EC80PL-01	CDI-170 Watt	BR9ES	RN-2C*	0.7/.028	CU2196	FP6369

* Original Equipment

Running Ignition Timing at 3000 RPM						Operating Timing and RPM
Engine Model	MM BTDC	Inches BTDC	Degrees BTDC	Acceptable Variances		
				MM	Inches	
EC25PS-07	4.05	.159	27±3	3.22-4.96	.127-.195	20.5° @ 6000
EC34-2PM-02/04	3.28	.129	25±1.5	2.90-3.67	.114-.144	16° @ 7000
EC44-3PM-01	3.81	.150	26±1.5	3.39-4.25	.133-.167	16° @ 6500
EC50PM-01/02/03	3.81	.150	26±1.5	3.39-4.25	.133-.167	16° @ 6500
EC45PL-01/02	4.40	.173	28±1.5	3.91-4.87	.156-.191	16° @ 7500
EC50PL-05/06	4.40	.173	28±1.5	3.91-4.87	.156-.191	16° @ 7500
EC50PL-07/08	4.71	.185	29±1.5	4.25-5.20	.167-.204	17° @ 7500
EC58PL-01	4.40	.173	28±1.5	3.91-4.87	.156-.191	20° @ 7500
EC65PL-05/06	3.53	.139	25±1.5	3.13-4.01	.123-.156	19° @ 7500
EC80PL-01	2.96	.116	22±1.5	2.58-3.10	.102-.133	11° @ 8000

156 = 191
Timing of mm
from 15
7500. 20°
20°

ENGINE ELECTRICAL Ignition Data

1995 Models

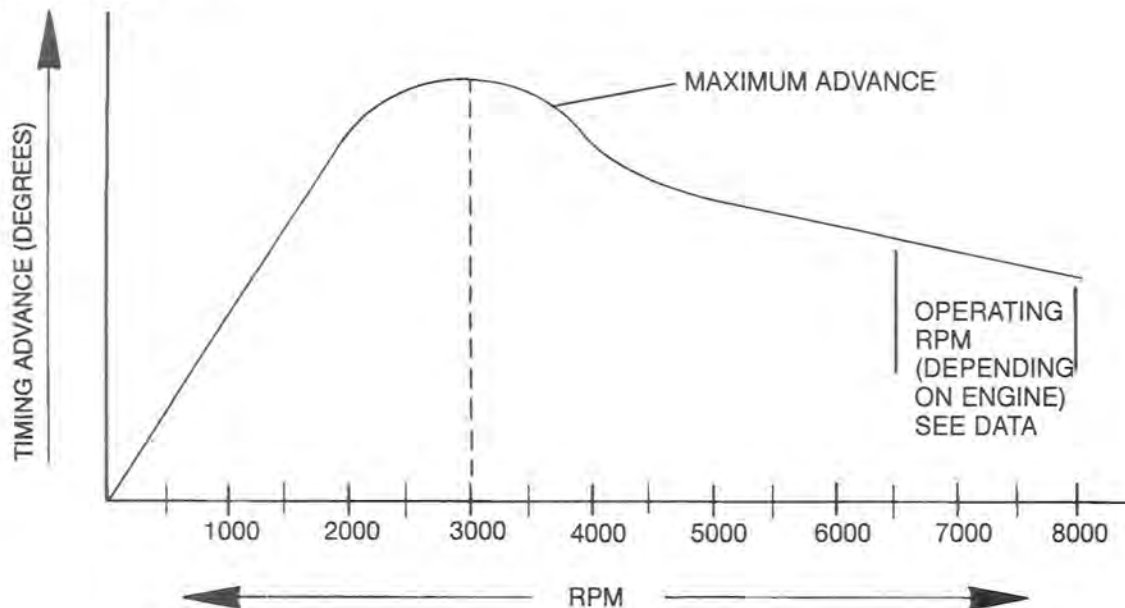
Machine Model	Engine Model	Alternator Wattage	Spark Plug		Plug Gap MM/Inches	CDI Box Identification Number	Fly-wheel ID #
			NGK	Champion			
StarLite	EC25PS07	150	BR8ES	RN-3C	0.7/.028	CU6204	FP5355
IndyLite Models	EC34-2PM02/E02	150	BR8ES	RN-3C	0.7/.028	CU6409	FP5439
Indy Sport Models	EC44-3PM01/02	200	BR8ES	RN-3C	0.7/.028	CU6416	FP5446
Indy Trail Models	EC50PM04/E04	200	BR8ES	RN-3C	0.7/.028	CU6413	FP5441
WideTrak GT	EC50PM03	200	BR8ES	RN-3C	0.7/.028	CU6413	FP5441
Indy 440 LC/SKS	EC45PL02	200	BR8ES	RN-3C	0.7/.028	CU6415	FP5445
Indy XCR	EC45PL03	200	BR9ES	RN-2C	0.7/.028	CU6415	FP5445
Indy 500/Classic	EC50PL04/E04	200	BR8ES	RN-3C	0.7/.028	CU6415	FP5445
WideTrak LX	EC50PL06	200	BR8ES	RN-3C	0.7/.028	CU6415	FP5445
500 EFI	EC50PL07	250	BR8ES	RN-3C	0.7/.028	CU6415	FP5508
XLT/XLT SP/XLT SKS	EC58PL03	170	BR8ES	RN-3C	0.7/.028	CU2194	FP8312
Indy XCR 600	EC5802	170	BR9ES	RN-2C	0.7/.028	CU2194	FP8312
XLT Touring	EC58PLE04	170	BR8ES	RN-3C	0.7/.028	CU2194	FP8312
Indy RXL/Touring	EC65PL05/E05	180	BR9ES	RN-2C	0.7/.028	CU2178	FP6392
Indy Storm	EC80PL01	180	BR8ES	RN-3C	0.7/.028	CU2508	FP6398

Running Ignition Timing at 3000 RPM						Operating Timing °BTDC RPM
Engine Model	MM BTDC	Inches BTDC	Degrees BTDC	Acceptable Variances		
				MM	Inches	
EC25PS07	4.05	.159	27±3	3.22-4.96	.127-.195	20.5° @ 6000
EC342PM02/E02	3.67	.145	26.5±1.5	3.28-4.08	.129-.161	15.5° @ 7000
EC443PM01/02	3.81	.150	26±1.5	3.39-4.25	.133-.167	16° @ 6500
EC50PM04/E04	3.81	.150	26±1.5	3.39-4.25	.133-.167	16° @ 6500
EC50PM03	4.71	.185	29±1.5	4.25-5.20	.167-.204	19° @ 7500
EC45PL02/03	4.40	.173	28±1.5	3.91-4.87	.156-.191	16° @ 7500
EC50PL04/E04/06	4.40	.173	28±1.5	3.91-4.87	.156-.191	16° @ 7500
EC50PL07	4.71	.185	29±1.5	4.25-5.20	.167-.204	17° @ 7500
EC58PL02/03/E04	4.40	.173	28±1.5	3.91-4.87	.156-.191	20° @ 7500
EC65PL05/E05	3.53	.139	25±1.5	3.13-4.01	.123-.156	19° @ 7500
EC80PL01	2.96	.116	22±1.5	2.58-3.10	.102-.133	11° @ 8000

ENGINE ELECTRICAL

Typical 1985 - Current Timing Advance Curves

Ignition Timing



NOTE: Always verify timing of engine at room temperature only (68° F/20° C).

The ignition maximum advance is at or near 3000 RPM on all current style ignition systems. Verify the ignition position at maximum advance when checking the timing.

If engine damage has occurred due to a suspected ignition related problem, check the ignition timing at the specified operating RPM.

Due to differences between engines, it is necessary to dial indicate the timing marks on all engines before attempting to adjust the ignition timing. To indicate the marks:

1. Remove the mag cylinder spark plug and install the dial indicator.
2. Rotate the crankshaft by hand while observing the dial indicator. As the piston touches the indicator plunger, the dial will begin to rotate. Find the point where the pointer stops rotating and reverses direction. This will be TDC (Top Dead Center).
3. While holding the crankshaft with the piston at TDC, zero the indicator by rotating the bezel until the O on the dial and the pointer align.
4. Rotate the crankshaft opposite the direction of rotation about .250 BTDC (2 1/2 pointer revolutions).
5. Determine the correct ignition timing position from the ignition data charts and rotate the crankshaft in the normal direction of rotation to that position. (Example: 1993 EC50PM-01 engine timing is .150 BTDC. The crankshaft must be rotated in the normal direction of rotation so that the dial indicator pointer does one complete revolution and stops on 50. This should be 1 1/2 pointer revolutions before top center, or .150 BTDC.
6. While holding the crankshaft at the correct timing position, determine which of the rotating and stationary timing lines align. Mark these lines with chalk or a marker to make them easier to identify when you are doing the running timing.



ENGINE ELECTRICAL Conversion Chart - Degrees to Piston Position - B.T.D.C.

If the ignition timing specification is listed in degrees only, convert to either inches or mm BTDC and use a dial indicator to verify timing marks. **NOTE:** Due to differing rod lengths and engine strokes, consult the engine model list for correct engine.

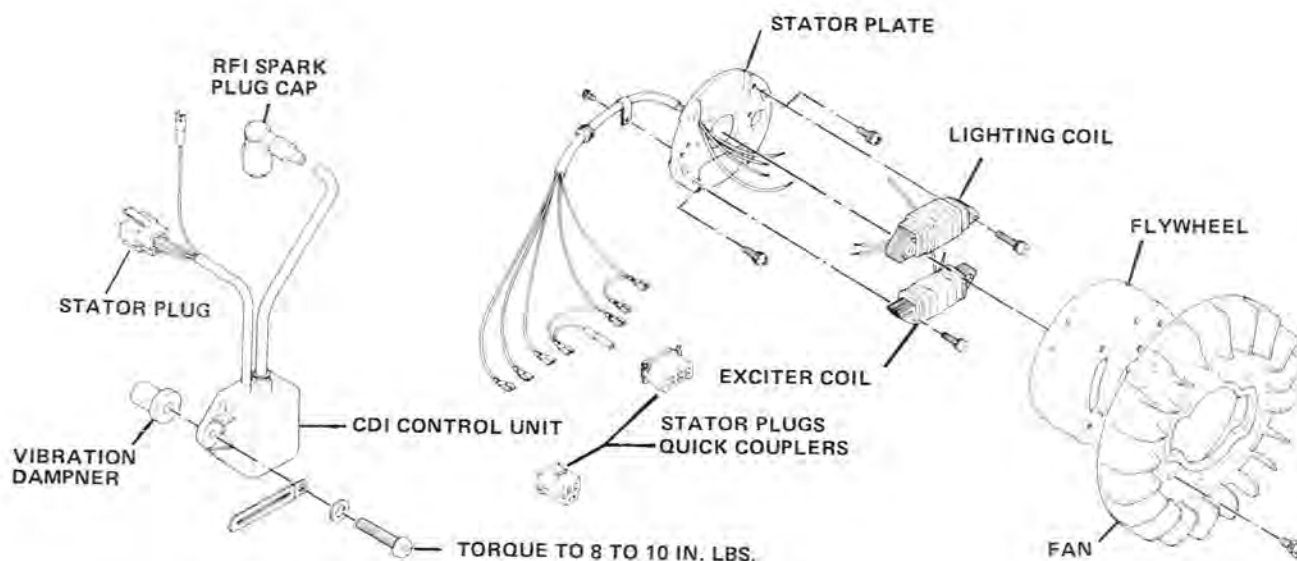
Engine Model	EC40PL EC44-2PM EC44-3PM EC45PL EC50PL EC60PL EC58PL EC65PL		EC35PL		EC75PL EC80PL		EC34-2PM		EC25PF EC25PS EC44PT EC44PQ EC44PM	
DEG. BTDC	112 MM ROD 60 MM STROKE		130 MM ROD 70 MM STROKE		125 MM ROD 65 MM STROKE		103 MM ROD 55.6 MM STROKE		120 MM ROD 60 MM STROKE	
	MM	INCHES	MM	INCHES	MM	INCHES	MM	INCHES	MM	INCHES
1	0.0058	0.0002	0.0068	0.0003	0.0062	0.0002	0.0054	0.0002	0.0057	0.0002
2	0.0232	0.0009	0.0271	0.0011	0.0249	0.0010	0.0215	0.0008	0.0228	0.0009
3	0.0521	0.0021	0.0609	0.0024	0.0561	0.0022	0.0484	0.0019	0.0514	0.0020
4	0.0926	0.0036	0.1082	0.0043	0.0997	0.0039	0.0860	0.0034	0.0913	0.0036
5	0.1447	0.0057	0.1690	0.0067	0.1558	0.0061	0.1343	0.0053	0.1426	0.0056
6	0.2083	0.0082	0.2432	0.0096	0.2242	0.0088	0.1933	0.0076	0.2053	0.0081
7	0.2833	0.0112	0.3309	0.0130	0.3050	0.0120	0.2630	0.0104	0.2793	0.0110
8	0.3698	0.0146	0.4319	0.0170	0.3981	0.0157	0.3432	0.0135	0.3646	0.0144
9	0.4677	0.0184	0.5463	0.0215	0.5036	0.0198	0.4341	0.0171	0.4612	0.0182
10	0.5770	0.0227	0.6739	0.0265	0.6212	0.0245	0.5355	0.0211	0.5689	0.0224
11	0.6976	0.0275	0.8147	0.0321	0.7510	0.0296	0.6474	0.0255	0.6878	0.0271
12	0.8294	0.0327	0.9687	0.0381	0.8930	0.0352	0.7698	0.0303	0.8178	0.0322
13	0.9724	0.0383	1.1357	0.0447	1.0470	0.0412	0.9025	0.0355	0.9588	0.0377
14	1.1265	0.0444	1.3157	0.0518	1.2129	0.0478	1.0456	0.0412	1.1108	0.0437
15	1.2917	0.0509	1.5086	0.0594	1.3908	0.0548	1.1989	0.0472	1.2737	0.0501
16	1.4678	0.0578	1.7143	0.0675	1.5804	0.0622	1.3624	0.0536	1.4474	0.0570
17	1.6548	0.0652	1.9327	0.0761	1.7818	0.0701	1.5359	0.0605	1.6318	0.0642
18	1.8526	0.0729	2.1637	0.0852	1.9948	0.0785	1.7195	0.0677	1.8269	0.0719
19	2.0611	0.0811	2.4072	0.0948	2.2193	0.0874	1.9130	0.0753	2.0326	0.0800
20	2.2802	0.0898	2.6631	0.1048	2.4552	0.0967	2.1163	0.0833	2.2487	0.0885
21	2.5098	0.0988	2.9312	0.1154	2.7024	0.1064	2.3294	0.0917	2.4752	0.0974
22	2.7497	0.1083	3.2114	0.1264	2.9608	0.1166	2.5521	0.1005	2.7119	0.1068
23	3.0000	0.1181	3.5036	0.1379	3.2303	0.1272	2.7843	0.1096	2.9587	0.1165
24	3.2603	0.1284	3.8077	0.1499	3.5107	0.1382	3.0260	0.1191	3.2156	0.1266
25	3.5307	0.1390	4.1235	0.1623	3.8019	0.1497	3.2769	0.1290	3.4824	0.1371
26	3.8110	0.1500	4.4508	0.1752	4.1038	0.1616	3.5370	0.1393	3.7590	0.1480
27	4.1010	0.1615	4.7895	0.1886	4.4161	0.1739	3.8062	0.1498	4.0452	0.1593
28	4.4007	0.1733	5.1395	0.2023	4.7389	0.1866	4.0843	0.1608	4.3410	0.1709
29	4.7098	0.1854	5.5005	0.2166	5.0719	0.1997	4.3712	0.1721	4.6461	0.1829
30	5.0282	0.1980	5.8724	0.2312	5.4149	0.2132	4.6667	0.1837	4.9604	0.1953
31	5.3559	0.2109	6.2550	0.2463	5.7679	0.2271	4.9708	0.1957	5.2839	0.2080
32	5.6926	0.2241	6.6482	0.2617	6.1306	0.2414	5.2832	0.2080	5.6163	0.2211
33	6.0381	0.2377	7.0517	0.2776	6.5028	0.2560	5.6039	0.2206	5.9575	0.2345
34	6.3924	0.2517	7.4654	0.2939	6.8845	0.2710	5.9326	0.2336	6.3073	0.2483
35	6.7552	0.2660	7.8891	0.3106	7.2754	0.2864	6.2693	0.2468	6.6656	0.2624
36	7.1263	0.2806	8.3225	0.3277	7.6753	0.3022	6.6138	0.2604	7.0322	0.2769
37	7.5057	0.2955	8.7655	0.3451	8.0840	0.3183	6.9658	0.2742	7.4069	0.2916
38	7.8931	0.3108	9.2179	0.3629	8.5015	0.3347	7.3253	0.2884	7.7896	0.3067
39	8.2883	0.3263	9.6795	0.3811	8.9274	0.3515	7.6920	0.3028	8.1801	0.3221
40	8.6912	0.3422	10.1499	0.3996	9.3616	0.3686	8.0659	0.3176	8.5782	0.3377

ENGINE ELECTRICAL

Single Cylinder CDI Ignition - Exploded View - Timing

Timing Procedure - Single Cylinder Models

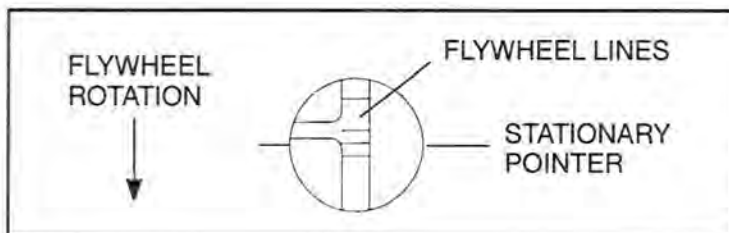
Single Cylinder Capacitor Ignition System



NOTE: Always verify timing of engine at room temperature only (68° F/20° C).

7. Verify and mark which flywheel timing line corresponds with the listed ignition timing from the chart at the beginning of this unit. Refer to the method of using a dial indicator for verifying the timing marks, shown on page 4.12.
8. Connect an accurate tach and a good quality timing light to the engine.
9. With the engine running at 3000 RPM, point the timing light at the timing hole.

NOTE: Your sight line during the timing mark verification (dial indicator check) and the actual running timing light check, must be the same.



10. Position your head so there is a straight line between your eye, the static timing pointers, and the crankshaft center line. Note the relative position between the flywheel mark and the stationary pointer. If the flywheel mark is within the acceptable +/- variance, the timing is correct. If the mark is outside the variance, then the stator will have to be rotated either with crankshaft rotation to retard timing, or against rotation to advance it.

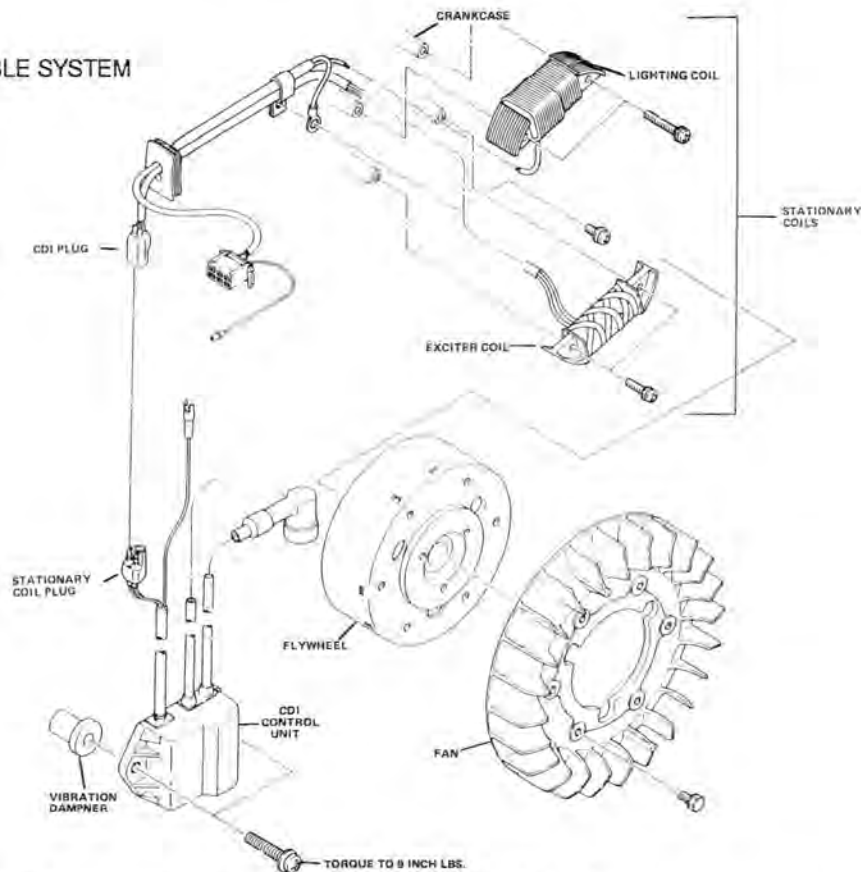
NOTE: The recoil and recoil cup must be removed to loosen stator bolts and change the timing.

11. Make sure all nuts and bolts are properly tightened after making adjustments.

ENGINE ELECTRICAL Twin Cylinder Fan CDI Ignition (Fixed) - Exploded View - Timing

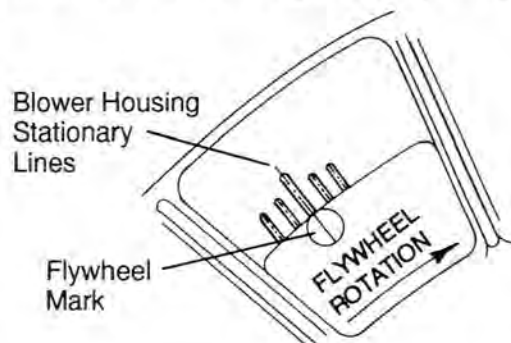
Timing Procedure

NON ADJUSTABLE SYSTEM



NOTE: Always verify timing of engine at room temperature only (68° F/20° C).

12. Verify and mark which flywheel timing line corresponds with the listed ignition timing from the chart at the beginning of this unit. Refer to the method of using a dial indicator for verifying timing marks described on page 4.12.
13. Connect an accurate tach and a good quality timing light to the engine.



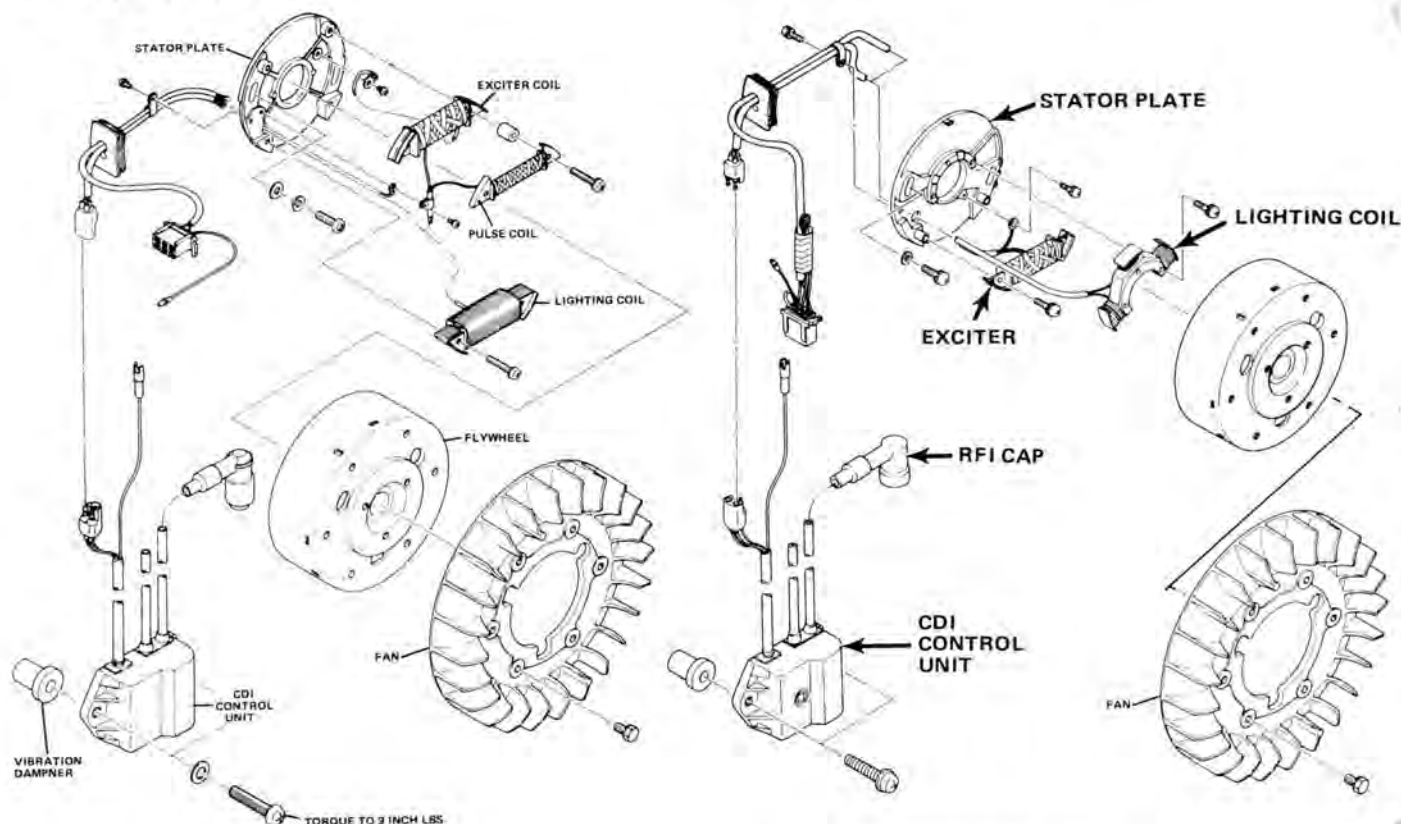
NOTE: Acceptable variance is usually one line on either side of the dial indicated blower housing stationary line.

14. With the engine running at 3000 RPM, point the timing light at the blower housing stationary lines. If the flywheel mark aligns with the correct stationary line or anywhere in the acceptable +/- variance, the timing is correct. If the timing is not correct, follow steps 4 through 7, re-checking the timing after each step.
15. Disconnect the ignition kill circuit by disconnecting the black wire at the CDI module.
16. Check the exciter coil resistance and replace if necessary.
17. Replace the CDI module.
18. Replace the flywheel.

ENGINE ELECTRICAL

Twin Cylinder Fan CDI Ignition (Adjustable) - Exploded View - Timing

Timing Procedure

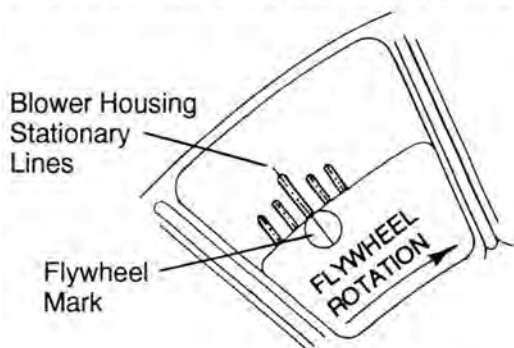


120 Watt Pulse Type

150 and 200 Watt Pulseless

NOTE: Always verify timing of engine at room temperature only (68° F/20° C).

19. Verify and mark which blower housing timing line corresponds with the listed ignition timing from the charts at the beginning of this unit. Refer to the method of using a dial indicator for verifying timing marks described on page 4.12.
20. Connect an accurate tach and a good quality timing light to the engine.

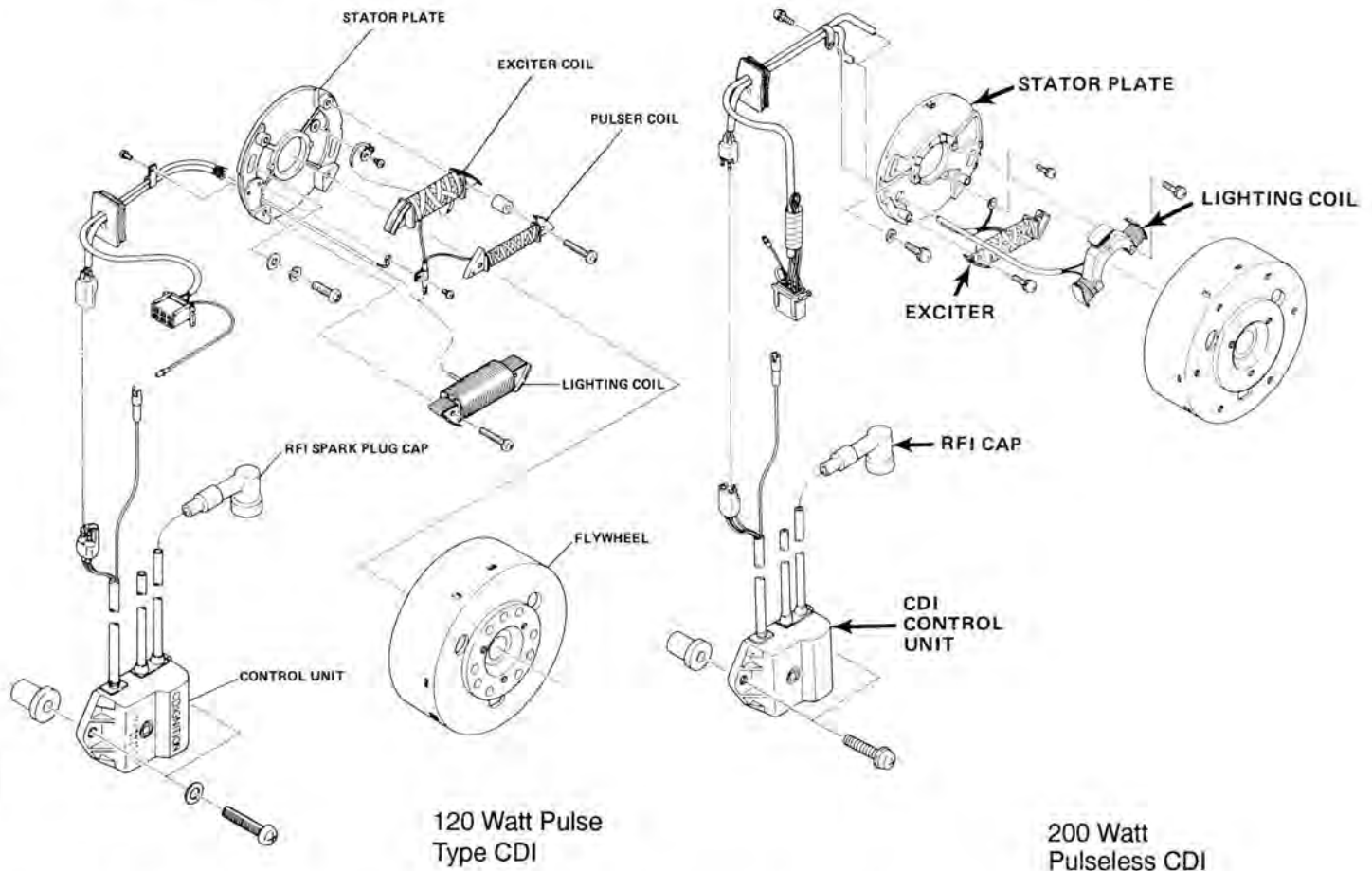


NOTE: Acceptable variance is usually one line on either side of the dial indicated blower housing stationary line.

21. With the engine running at 3000 RPM, point the timing light at the blower housing stationary lines. If the flywheel mark aligns with the correct stationary line or anywhere in the acceptable +/- variance, the timing is correct.
22. If the mark is outside the acceptable variance, the stator must be either rotated with crankshaft rotation to retard the timing, or against rotation to advance it. **NOTE:** The recoil and recoil cup must be removed to loosen the stator bolts and change the timing.
23. Make sure all nuts and bolts are properly tightened after making adjustments.

Twin Cylinder Liquid CDI Ignition (Pulse, Pulseless) - Exploded View - Timing

Timing Procedure

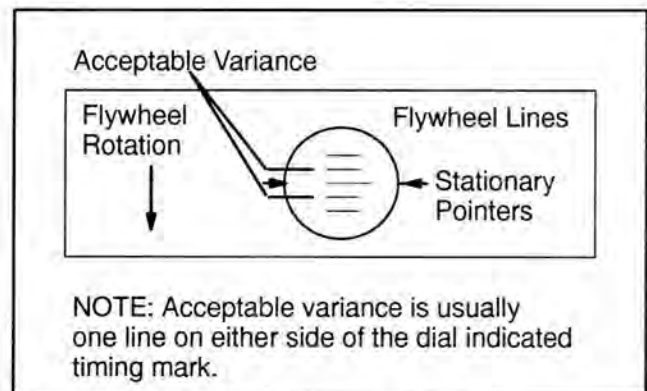


120 Watt Pulse
Type CDI

200 Watt
Pulseless CDI

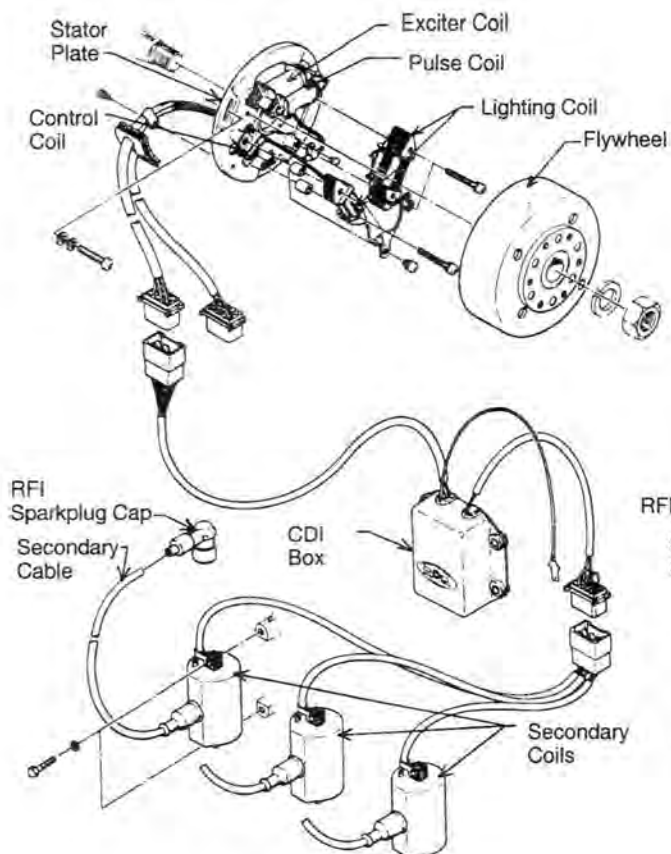
NOTE: Always verify timing of engine at room temperature only (68° F/20° C).

24. Verify and mark which flywheel timing line corresponds with the listed ignition timing from the chart at the beginning of this unit. Refer to the method of using a dial indicator for verifying timing marks described on page 4.12.
25. Connect an accurate tach and a good quality timing light to the engine.
26. With the engine running at 3000 RPM point the timing light at the timing hole.
27. Position your head so there is a straight line between your eye, the stationary timing pointer, and the crankshaft center line. Note the relative position between the flywheel mark and the stationary pointer. If the flywheel mark is within the acceptable +/- variance, the timing is correct. If the mark is outside the variance, the stator will have to be rotated either with crankshaft rotation to retard timing, or against rotation to advance it.
NOTE: The recoil and recoil cup must be removed to loosen stator bolts and change the timing.
28. Make sure all nuts and bolts are properly tightened after making adjustments.

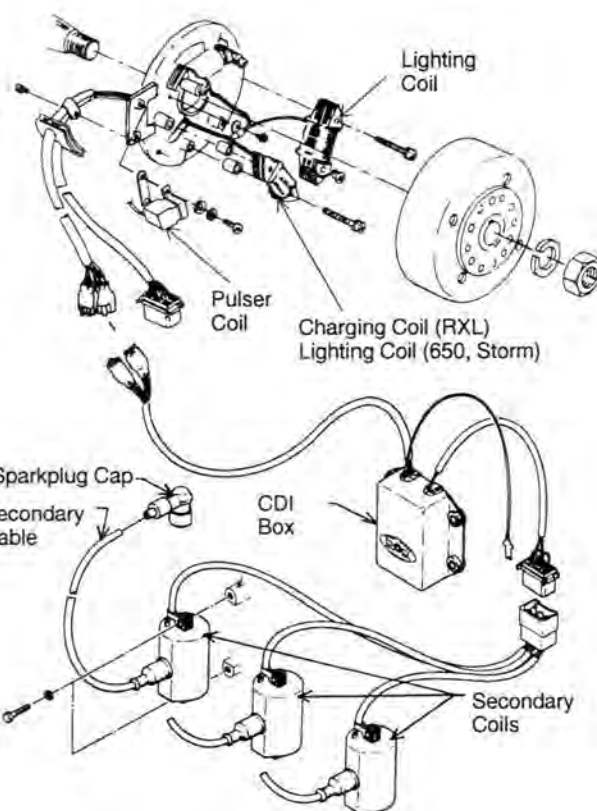


ENGINE ELECTRICAL

Three Cylinder CDI Ignition (Pulse, Trigger) Timing - Exploded View



1985 - 1990
3 Cylinders (Except RXL)

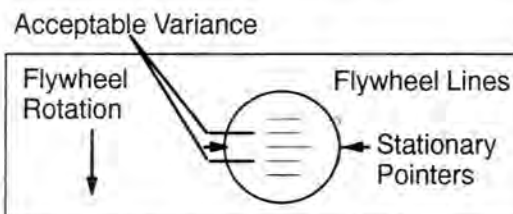


All RXL's, 1991 and Later 650's,
1993 to Current Storms 180 Watt

Timing Procedure: Three Cylinder Models

NOTE: Always verify timing of engine at room temperature only (20°C/68°F).

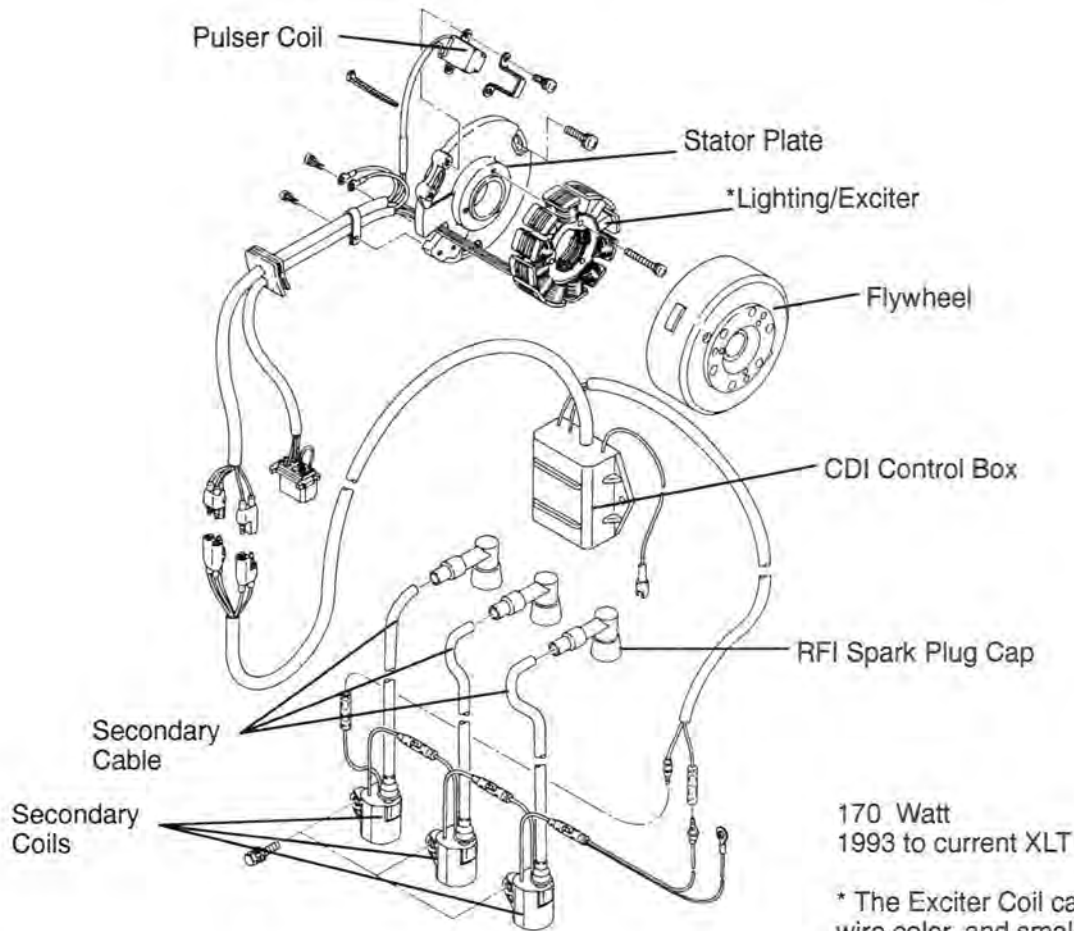
1. Verify and mark which flywheel timing line corresponds with the listed ignition timing from the chart at the beginning of this section. Refer to the method of dial indicator use for verifying timing marks described on page 4.12.
2. Connect an accurate tach and a good quality timing light to the engine.
3. With the engine running at 3000 RPM, point the timing light at the timing hole.
4. With your head positioned so there is a straight line between your eye, the stationary pointer and the crankshaft center line, note the relative position between the marked flywheel line and the stationary pointer. If the stationary pointer is within the acceptable \pm variance, the timing is correct. If the pointer is outside the variance, the stator will have to be rotated either with crankshaft rotation to retard the timing, or against rotation to advance it. **NOTE:** The recoil and recoil cup must be removed to loosen the stator bolts and change the timing.
5. Make sure all nuts and bolts are properly tightened after making adjustments.



NOTE: Acceptable variance is usually one line on either side of the dial indicated timing mark.

ENGINE ELECTRICAL

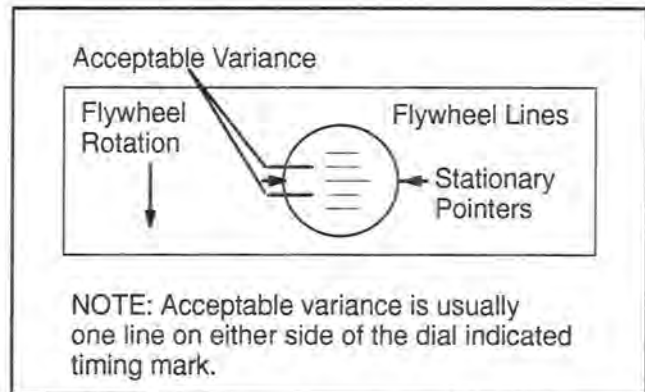
Three Cylinder CDI Ignition (Storm/XLT) Timing - Exploded View



Timing Procedure: Three Cylinder Models

NOTE: Always verify timing of engine at room temperature only (20°C/68°F).

1. Verify and mark which flywheel timing line corresponds with the listed ignition timing from the chart at the beginning of this section. Refer to the method of dial indicator use for verifying timing marks described on page 4.12.
2. Connect an accurate tach and a good quality timing light to the engine.
3. With the engine running at 3000 RPM, point the timing light at the timing hole.
4. With your head positioned so there is a straight line between your eye, the stationary pointer and the crankshaft center line, note the relative position between the marked flywheel line and the stationary pointer. If the stationary pointer is within the acceptable \pm variance, the timing is correct. If the pointer is outside the variance, the stator will have to be rotated either with crankshaft rotation to retard the timing, or against rotation to advance it. **NOTE:** The recoil and recoil cup must be removed to loosen the stator bolts and change the timing.
5. Make sure all nuts and bolts are properly tightened after making adjustments.



ENGINE ELECTRICAL

Operating RPM Timing Check - All Models

CAUTION:

Due to the high RPM necessary and the possible danger involved, special care must be observed whenever performing an operating RPM timing check to avoid serious personal injury.

This check need not be performed unless symptoms leading to poor performance and possible engine damage are present.

- Never operate the engine with the clutch guard open or removed.
- Do not stand over or around the clutch while performing this test.
- Perform the test as quickly as possible. Avoid prolonged periods of engine free-rev.

Operating RPM Timing Test Procedure

29. Using the charts at the beginning of this unit, determine the ignition advance BTDC at the operating RPM.
30. Remove the mag side spark plug and install a dial indicator in that cylinder.
31. Zero the dial indicator as explained on page 4.12.
32. Turn the crankshaft in the opposite direction of rotation to a point approximately .100" (2.5 mm) before the operating ignition timing point.
33. Turn the crankshaft in the proper direction of rotation until the dial indicator shows the proper piston position BTDC for operating RPM ignition timing. **NOTE:** The charts only indicate degrees BTDC. This figure must be converted using the tables on page 4.13. Example: The operating timing and RPM for a 1993 EC45PL-02 engine is 16° at 7500 RPM. Using the chart, 16° on this engine is .058 BTDC at 7500 RPM. Using a properly installed and zeroed dial indicator, back the engine up to approximately .150 BTDC. Then rotate the crank in the proper direction of rotation to .058 BTDC.
34. While holding the crankshaft at the operating RPM ignition timing point, make some timing marks on the flywheel or blower housing using a piece of chalk or marker.
35. Remove the dial indicator and reinstall spark plug.
36. Start the engine. Advance and hold the throttle at the operating RPM specified on the charts. View the timing mark with the timing light. The marks should be between the allowable +/- variance indicated on the operating RPM timing specification.
37. If the operating RPM timing greatly varies from the specification, but the 3000 RPM ignition is correct, refer to the ignition troubleshooting section in this unit for corrective action.

ENGINE ELECTRICAL Ignition System Testing

Ignition system components can be individually tested by measuring their internal resistance and insulation to ground. These checks **must** be done with a digital volt/ohm meter. Compare the readings obtained to the values listed on the chart. Actual values may vary up to $\pm 10\%$ between like components. Any readings outside the span should be considered questionable.

NOTE: The stator coils can be checked without removing them from the engine. Simply disconnect the connector plug in the stator-to-CDI wire and check the resistance values between the wire colors listed below. Consult the stator schematics shown on the next pages.

* Indicates a system that incorporates a white CDI-to-stator ground wire. These systems will indicate continuity between the exciter/pulser wires and ground.

	EXCITER COIL		PULSER COIL	
	Check Wires	Value	Check Wires	Value
SINGLE CYLINDER MODELS 1985-Current Star/Star LT StarLite	Brown/White to Black/Red	123 Ohms	Not Applicable	
TWIN CYLINDER MODELS All EC34-2PM (Pulseless)	Brown/White to Black/Red	164 Ohms	Not Applicable	
All EC40-PL/50PL thru 1989 All EC44-2PM	Brown/White to White	164 Ohms	Brown/White to Black/Red	45 Ohms
All EC40PL/50PL 1990 to current EC45PL (Pulseless) All EC50PM 1990 to current All EC44-3PM (Pulseless)	Brown/White to Black/Red	164 Ohms	Not Applicable	
All EC50PM thru 1989	Brown/White to White	164 Ohms	Brown/White to Black/Red	17 Ohms

* Indicates a system that incorporates a white CDI-to-stator ground wire. These systems will indicate continuity between the exciter/pulser wires and ground.

	EXCITER COIL		PULSER COIL		CONTROL COIL		TRIGGER COIL	
	Check Wires	Value	Check Wires	Value	Check Wires	Value	Check Wires	Value
THREE CYLINDER MODELS								
All EC58PL-01	Black/Red to Red	4.6 Ohms	White to White/Red	100 Ohms				
All EC60PL and EC65PL-01	Black to White	261 Ohms	Red to White	20 Ohms	Green to Blue	29.4 Ohms		
All EC65PL-02/03/05	Black/Red to Green	248 Ohms	Red to Green	20 Ohms			White to White/Red	96 Ohms
All EC75PL-01 and EC80PL-01	Black/Red to Green	248 Ohms	Red to Green	20 Ohms			White to White/Red	96 Ohms

Three Cylinder Models: Secondary Ignition Coil	EC58PL-01	EC60PL EC65PL-01	EC65PL 02/03/05	EC75PL-01 EC80PL-01
Primary Resistance Tab to Tab	.4 Ohms $\pm 15\%$.106 Ohms $\pm 15\%$.4 Ohms $\pm 15\%$.4 Ohms $\pm 15\%$
Secondary Resistance Tab to Plug Wire End (Cap Removed)	4 K Ohm $\pm 20\%$	2 K Ohm $\pm 20\%$	7.5 K Ohm $\pm 20\%$	7.5 K Ohm $\pm 20\%$
Spark Plug Cap	3.7 to 6.3 K Ohm	3.7 to 6.3 K Ohm	3.7 to 6.3 K Ohm	3.7 to 6.3 K Ohm

Secondary coils can also be dynamically tested with a coil power tester such as the Graham Lee Model 31. Consult the tester operation manual for specific operating instructions.

ENGINE ELECTRICAL Ignition / Charging System Testing

Stator Schematics

STATOR

EXCITER

LIGHTING

YEL

BRN/W BLK/R

BRN W

Single Cylinders EC-25-PS

Exciter Coil:		Lighting Coil:	
<u>Wire Color</u>	<u>Value</u>	<u>Wire Color</u>	<u>Value</u>
Brn/W to Blk/R	123 ohms	Yel to W or Brn	.3 to .6 ohms

Twin Cylinders

Exciter Coil:		Lighting Coil:	
<u>Wire Color</u>	<u>Value</u>	<u>Wire Color</u>	<u>Value</u>
Brn/W to Blk/R	164 ohms	Yel to W or Brn	.3 to .6 ohms

STATOR

EXCITER

PULSER

LIGHTING

YEL

BLK/R

W

BRN/W

BRN

Twin Cylinder EC40/50 PL through 1989 120 Watt
Pulse Type EC44-2PM 120 Watt

Exciter Coil:		Pulser Coil:	
<u>Wire Color</u>	<u>Value</u>	<u>Wire Color</u>	<u>Value</u>
Brn/W to W	164 ohms	Brn/W to Blk/R	45 ohms

Lighting Coil:

<u>Wire Color</u>	<u>Value</u>
Yel to Brn or W	.3 to .6 ohms

EC50PM through 1989 120 Watt

Exciter Coil:		Pulser Coil:	
<u>Wire Color</u>	<u>Value</u>	<u>Wire Color</u>	<u>Value</u>
Brn/W to W	164 ohms	Brn/W to Blk/R	17 ohms

Lighting Coil:

<u>Wire Color</u>	<u>Value</u>
Yel to Brn or W	.3 to .6 ohms

STATOR

EXCITER

LIGHTING

YEL

YEL/R

BLK/R

W

BRN/W

BRN

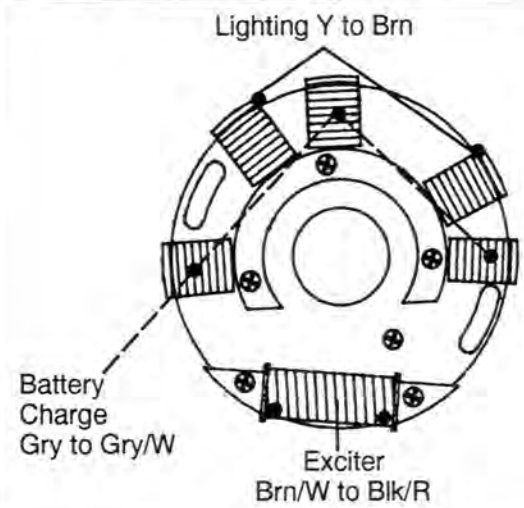
Twin Cylinder EC44-3PM 200 Watt
EC50-PM 200 Watt
EC40/45/40 PL 200 Watt

Exciter Coil:		Lighting Coil:	
<u>Wire Color</u>	<u>Value</u>	<u>Wire Color</u>	<u>Value</u>
Brn/W to Blk/R	164 ohms	Yel to Yel/R	.2 to .5 ohms

ENGINE ELECTRICAL Ignition / Charging System Testing

Stator Schematics

1992/1993
2 Cylinder **EC50PL-07 All 500 EFI Pulseless 200 Watt**

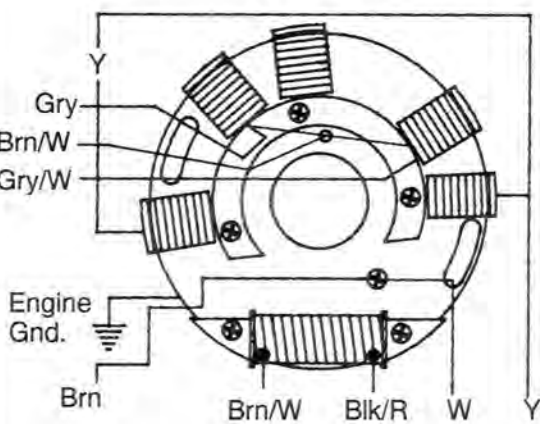


Exciter Coil:
Wire Color Value
 Brn/W to Blk/R 164 ohms

Battery Charge Coil:
Wire Color Value
 Gry to Gry/W .2 to .4 ohms

Lighting Coil:
Wire Color Value
 Y to Brn .2 to .4 ohms

1994 to Current
2 Cylinder **EC50PL-07/08 500 EFI Pulseless 250 Watt**

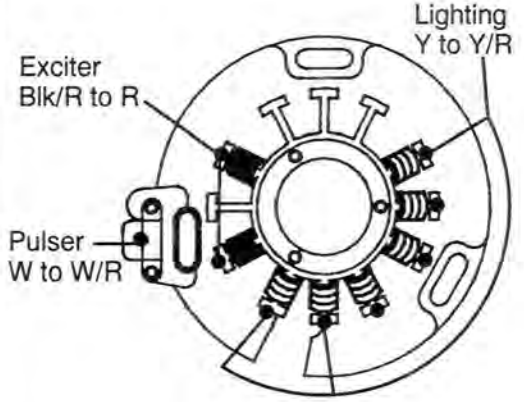


Exciter Coil:
Wire Color Value
 Brn/W to Blk/R 164 ohms

Battery Charge Coil:
Wire Color Value
 Gry to Gry/W .4 to .8 ohms
 Brn/W to Gry/W .2 to .4 ohms
 Open to Ground

Lighting Coil:
Wire Color Value
 Y to Brn .2 to .4 ohms

1993 to Current
3 Cylinder **EC58PL 170 Watt**



Exciter Coil:
Wire Color Value
 Blk/R to R 4.6 ohms

Battery Charge Coil:
Wire Color Value
 W to W/R 100 ohms

Lighting Coil:
Wire Color Value
 Y to Y/R .2 to .4 ohms

ENGINE ELECTRICAL

Ignition / Charging System Testing

Stator Schematics

1983-1992
3 Cylinder **EC60PL and EC65PL-01/02**

Exciter Coil:		Pulser Coil:	
<u>Wire Color</u>	<u>Value</u>	<u>Wire Color</u>	<u>Value</u>
Blk to W	261 ohms	R to W	20 ohms

Lighting Coil:		Control Coil:	
<u>Wire Color</u>	<u>Value</u>	<u>Wire Color</u>	<u>Value</u>
Y to Brn or Ground	.3 to .5 ohms	Grn to Blu	29.4 ohms

NOTE: All Values are $\pm 10\%$

1990-1991
3 Cylinder **EC65PL-03 RXL 180 Watt**

Exciter Coil:		Pulser Coil:	
<u>Wire Color</u>	<u>Value</u>	<u>Wire Color</u>	<u>Value</u>
Blk/R to Grn	248 ohms	R to Grn	20 ohms

Lighting Coil:		Trigger Coil:	
<u>Wire Color</u>	<u>Value</u>	<u>Wire Color</u>	<u>Value</u>
Y to Brn Open to Ground	.2 to .4 ohms	W to W/R	96 ohms

Battery Charge Coil:

<u>Wire Color</u>	<u>Value</u>
Gry to Gry/W Open to Ground	.3 to .5 ohms

1992 to Current
3 Cylinder **EC65PL 180 Watt**

Exciter Coil:		Pulser Coil:	
<u>Wire Color</u>	<u>Value</u>	<u>Wire Color</u>	<u>Value</u>
Blk/R to Grn	248 ohms	R to Grn	20 ohms

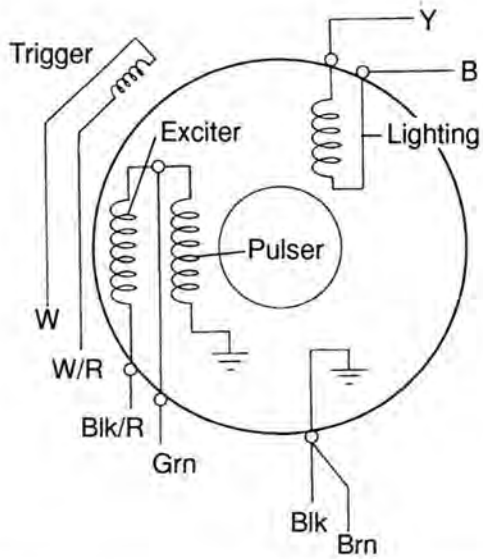
Lighting Coil:		Trigger Coil:	
<u>Wire Color</u>	<u>Value</u>	<u>Wire Color</u>	<u>Value</u>
Y to Brn	.2 to .4 ohms	W to W/R	96 ohms

Battery Charge Coil:

<u>Wire Color</u>	<u>Value</u>
Gry to Gry/W	.4 to .8 ohms
Brn/W to Gry/W	.3 to .5 ohms
Open to Ground	

ENGINE ELECTRICAL Ignition / Charging System Testing

Stator Schematics



1993 to Current

3 Cylinder

EC75PL-01 Storm 180 Watt
EC80PL-01 Storm

Exciter Coil:

Wire Color

Blk/R to Grn

Value

248 ohms

Pulser Coil:

Wire Color

Grn to Blk

Value

20 ohms

Lighting Coil:

Wire Color

Y to Brn

Value

.2 to .4 ohms

Trigger Coil:

Wire Color

W to W/R

Value

96 ohms

ENGINE ELECTRICAL

Ignition System Troubleshooting

Condition: No Spark

Disconnect the single black (black/white) wire from the CDI Module to the ignition kill circuit. Does it have a spark? Yes→ No↓	Check the ignition switch, wire harness, throttle safety switches and kill switch for proper adjustment or short to ground. Repair or replace as necessary.
Disconnect the stator to CDI module wires. Test the resistance values of the flywheel coils as per the charts on page 4.21. Are the resistance values within specs? Yes→ No↓	All except 3 cylinders: If the parts of the ignition system under the flywheel check OK, the only remaining component is the coil/CDI module assembly. Replace the module with another with the same CU number. (See ignition data) All 3 cylinders: Disconnect and check the secondary ignition coil resistances. Refer to the resistance values listed on IVa-10. If the coil resistance values are within specs, replace the CDI module.
Isolate which component's resistance is not within specs. Remove the flywheel and stator. Recheck the resistances; look for pinched or bare harness wires; or replace the coil. Refer to page 4.28 for coil replacement procedures.	

Condition: Incorrect Advance/Retard

Follow the engine timing procedure for checking running timing at 3000 RPM. Is the timing within limits? No→ Yes↓	Adjust the ignition timing by rotating the stator plate to correct the timing. After adjusting the 3000 RPM timing, continue with operating RPM timing if poor performance exists. (Continue on with left column.) See ignition timing page 4.20.
Follow the engine timing procedure for checking operating RPM timing from page 4.20. Is the timing within limits? Yes→ No↓	If the 3000 and operating RPM timing are within limits, no other testing is necessary.
Remove the ignition kill circuit by disconnecting the single black wire between the CDI module and the machine harness. Is the timing now correct? Yes→ No↓	Check the ignition switch, throttle safety switches, kill switch and harness for damage which can cause intermittent shorting problems. Correct the problem.
Verify the correct CDI module by comparing the CU code on the box to the information listed in the ignition data charts at the beginning of this section. Is it the right module? No→ Yes↓	Replace the module with the correct part and readjust the ignition timing.
Check the resistance of the coils under the flywheel. Compare these values to the charts on page 4.21. Are they within limits? No→ Yes↓	Check the wiring connecting the coils and/or replace the coils as necessary.
If the 3000 RPM timing is within limits but the operating RPM timing is not acceptable, replace the CDI module.	

NOTE: 3 cylinder engines fire three times per revolution. At 7500 RPM the ignition is firing 21,500 times per minute. Use of a timing light not capable of handling these RPMs may provide an incorrect operating RPM timing reading. Use timing light PN 2870630 or equivalent.

ENGINE ELECTRICAL Alternator Output Test - Open Circuit

CAUTION: Perform this test with a digital volt/ohm meter such as the Fluke 73 (PN 2870659), or equivalent. Set meter to AC volts (V~) when performing the test.

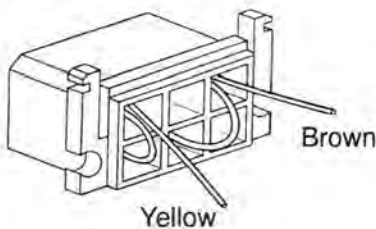
1. Disconnect alternator connector from engine.
2. Insert red test lead into yellow wire coming from engine alternator.
3. Black tester lead must be grounded to either the engine, a brown wire at the connector, or the yellow/red wire at the plug. See plug wire identification for proper hook-up.
4. Start engine and observe AC voltage reading on multimeter. Slowly increase RPM to 3000 and note voltage. The reading should be approximately 20 volts. Readings of 15 to 45 VAC are considered normal. If readings are low, remove flywheel and look for damaged magnets, shorted or damaged lead wires or damaged lighting coils. Repair or replace problem component and recheck.
5. On EFI models AC amps can be checked between Gray and Gray/White. At 5,000 RPM reading should be 7 amps.



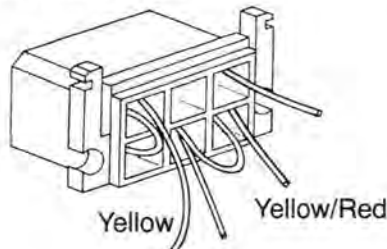
Lighting System Identification - Test between labeled wires.

Used On:

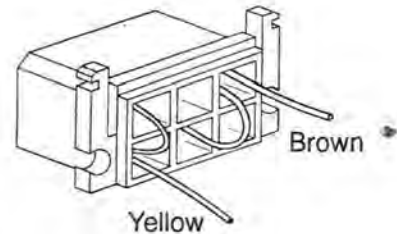
100 Watt Singles
120 Watt Twins



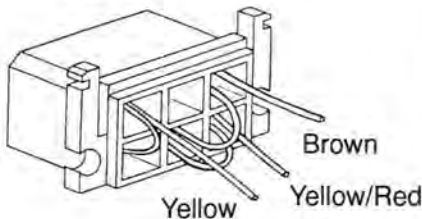
150 Watt Singles and Twins
200 Watt Twins



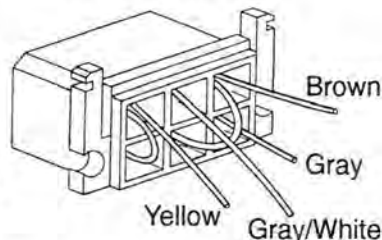
120 Watt 3 Cylinder



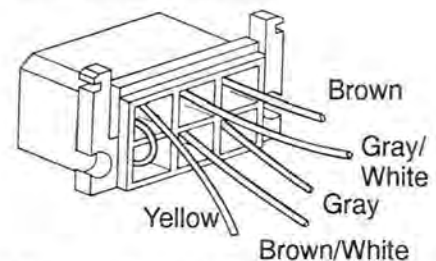
180 Watt 3 Cyl. (Carb.)
170 Watt 3 Cyl. (Carb.)



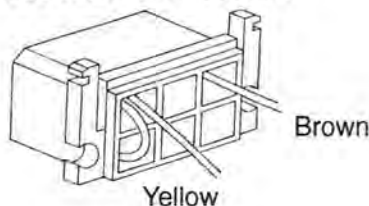
1990, 1991 RXL
1992, 1993 500 EFI



180 Watt
1992 to Current 650 EFI



250 Watt Twin - 500 EFI



Check Lighting Coil Between
Yellow and Brown.
Check Battery Charging
Between Gray and Gray/White.

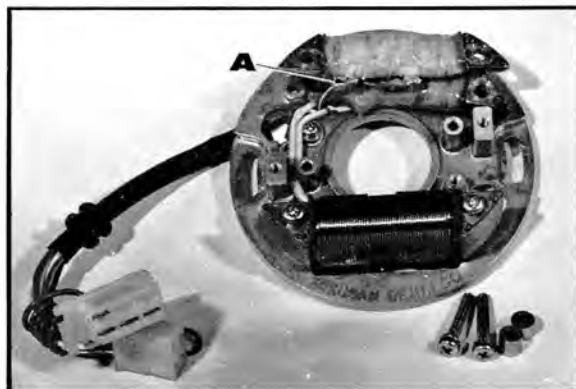
Check Lighting Coil Between
Yellow and Brown.
Check Battery Charging
Between Gray and Brown/White
and Gray/White and Brown/White.

NOTE: Gray, Gray/White, Brown/White are Bullet Type Connectors

ENGINE ELECTRICAL

Typical Exciter, Pulser or Lighting Coil Replacement

1. Remove coil retaining screws and spacers.
2. Using a pliers, remove epoxy from solder joints (A) on the coil to be replaced.



3. Unsolder connection from coil.



4. Clean solder terminals (B) on the replacement coil and re-solder to their proper wires. **NOTE:** Always position with numbers towards the outside.



5. Reinstall retaining screws and spacers.
6. Using a moisture-proof sealant, seal solder joints as shown. **NOTE:** All soldering must be done using rosin core solder.
7. Test resistance of each coil prior to stator plate installation.

NOTE: Lighting and pulseless coils are replaced in a similar manner.

IMPORTANT: After the stator plate is reinstalled on the engine, check placement of all coil leads to prevent possible contact with the flywheel.



ENGINE ELECTRICAL Battery Service

Preparing a New Battery for Service

To assure maximum service life and performance from a battery, it must have proper initial servicing. To service a new battery, the following steps must be taken. **NOTE:** Do not service the battery unless it will be put into regular service within 30 days.

1. Remove vent plug from vent fitting.
2. Fill battery with electrolyte to the upper level marks on the case.
3. Set battery aside and allow it to cool and stabilize for 30 minutes.
4. Add electrolyte to bring the level back to the upper level mark on the case. **NOTE:** This is the last time that electrolyte should be added. If the level becomes low after this point, add only distilled water.
5. Charge battery at 1/10 of its amp/hour rating.
Example: 1/10 of 9 amp battery = .9 amps, 1/10 of 14 amp battery = 1.4 amps, 1/10 of 18 amp battery = 1.8 amps (recommended charging rates).
6. Check specific gravity of each cell with a hydrometer to assure each has a reading of 1.270 or higher.

Battery Testing

There are three easy tests which can determine battery condition. Whenever the complaint is related to either the starting or charging systems, the battery should be checked first.

Lead-acid batteries should be kept at or as near full charge as possible. If the battery is stored or used in a partially charged condition, hard crystal sulfation will form on the plates, reducing their efficiency and possibly ruining the battery.

Open Circuit Voltage Test (OCV)

Battery voltage should be checked with a digital multimeter. Readings of 12.6 or less require further battery testing and charging.

Specific Gravity Test

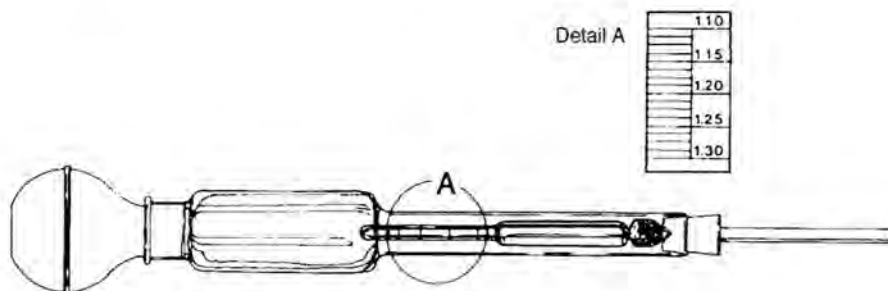
A tool such as the battery hydrometer (PN 2870836) can be used to measure electrolyte strength or specific gravity. As the battery goes through the charge/discharge cycle, the electrolyte goes from a heavy, more acidic state at full charge to a light, more water state when discharged. The hydrometer can measure state of charge and differences between cells in a multi-cell battery. Readings of 1.270 or greater should be observed in a fully charged battery. Differences of more than .025 between the lowest and highest cell readings indicate a need to replace the battery.

State Of Charge	Conventional Lead-acid	Yumacron Type
100% Charged	12.60V	12.70V
75% Charged	12.40V	12.50V
50% Charged	12.10V	12.20V
25% Charged	11.90V	12.0V
0% Charged	Less Than 11.80V	Less Than 11.9V

State Of Charge*	Conventional Lead-acid	Yumacron Type
100% Charged	1.265	1.275
75% Charged	1.210	1.225
50% Charged	1.160	1.175
25% Charged	1.120	1.135
0% Charged	Less Than 1.100	Less Than 1.115

*at 80° F

NOTE: Subtract .01 from the specific gravity for electrolyte at 40° F and compare these values to the chart.



ENGINE ELECTRICAL

Battery Service

Load Test

NOTE: This test can only be performed on machines equipped with electric start. This test cannot be performed if the engine or starting system is not working properly.

A battery may indicate a fully charge condition on the OCV test and the specific gravity test, but still not have the storage capacity necessary to properly function in the electrical system. For this reason, a battery capacity or load test should be conducted whenever poor battery performance is encountered.

To perform the test, hook a multimeter to the battery in the same manner as in the OCV test. The reading should be 12.6 volts or greater. Engage the electric starter and view the registered battery voltage while cranking the engine. Continue the test for 15 seconds. During this cranking period, the observed voltage should not drop below 9.5 volts. If the beginning voltage is 12.6 or higher and the cranking voltage drops below 9.5 volts during the test, replace the battery.

Refilling a Low Battery

The normal charge/discharge cycle of a battery causes the cells to give off gases. These gases, hydrogen and oxygen, are the components of water. Because of the loss of these gases and the lowering of the electrolyte level, it will be necessary to add pure, clean distilled water to bring the fluid to the proper level. After filling, charge the battery to raise the specific gravity to the fully charged position (1.270 or greater).

Off Season Storage

To prevent battery damage during extended periods of non-use, the following basic maintenance items must be performed.

1. Remove battery from machine and wash the case and battery tray with a mild solution of baking soda and water. Rinse with lots of fresh water after cleaning. **CAUTION:** Do not allow any of the baking soda solution to enter the battery or the acid will be neutralized.
2. Using a wire brush or knife, remove any corrosion from the cables and terminals.
3. Make sure the electrolyte is at the proper level. Add distilled water if necessary.
4. Charge at a rate no greater than 1/10 of the battery's amp/hr capacity until the electrolyte's specific gravity reaches 1.270 or greater.
5. The battery may be stored either in the machine with the cables disconnected, or on a piece of wood in a cool place. **NOTE:** Stored batteries lose their charge at the rate of 1% per day. They should be fully recharged every 30 to 60 days during a non-use period. If stored during winter months, the electrolyte will freeze at higher temperatures as the battery discharges. The chart indicates freezing points by specific gravity.

Specific Gravity of Electrolyte	Freezing Point
1.265	-75° F
1.225	-35° F
1.200	-17° F
1.150	+5° F
1.100	+18° F
1.050	+27° F

Charging Procedure

Charge battery with a charger no larger than 1/10 of the battery's amp/hr rating for as many hours as needed to raise the specific gravity to 1.270 or greater.

WARNING: The gases given off by a battery are explosive. Any spark or open flame near a battery can cause an explosion which will spray battery acid on anyone close to it. If battery acid gets on anyone, wash the affected area with large quantities of cool water and seek immediate medical attention.

Battery electrolyte is poisonous. It contains acid! Serious burns can result from contact with the skin, eyes, or clothing.

ANTIDOTE:

EXTERNAL: Flush with water.

INTERNAL: Drink large quantities of water or milk. Follow with milk of magnesia, beaten egg, or vegetable oil. Call physician immediately.

EYES: Flush with water for 15 minutes and get prompt medical attention.

Batteries produce explosive gases. Keep sparks, flame, cigarettes, etc. away. Ventilate when charging or using in closed space. Always shield eyes when working near batteries.

KEEP OUT OF REACH OF CHILDREN.

ENGINE ELECTRICAL

Dynamic Testing of Electric Starter System

Condition: Starter fails to turn motor or motor turns slowly.

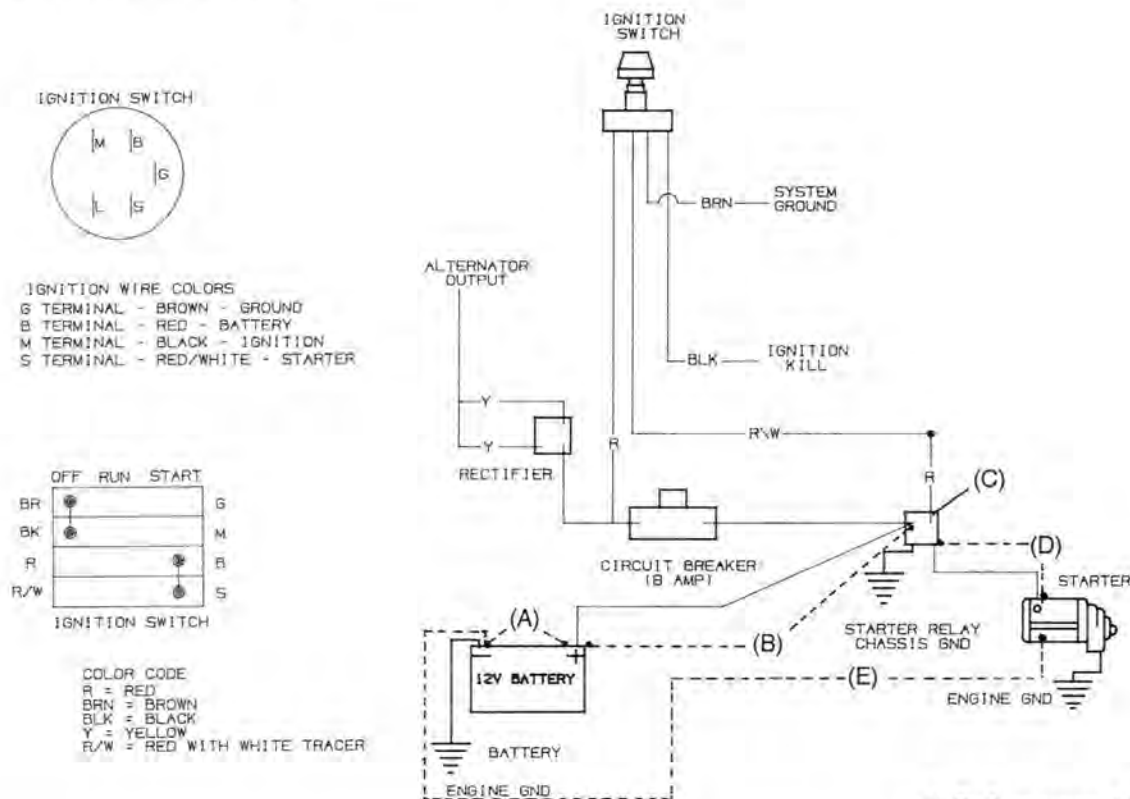
NOTE: Assure that engine crankshaft is free to turn before proceeding. For this test a digital multimeter must be used.

<p>With tester on VDC, place tester black lead on battery negative (-) terminal and tester red lead on battery positive (+) terminal. Reading should be 12.6V or greater. Is it?</p> <p style="padding-left: 40px;">No→ Yes↓</p> <p>(A) Page 4.32</p>	<p>Remove battery, test and/or service. Install a fully charged shop battery to continue the test.</p> <p>(Continue with left column)</p>
<p>Disconnect red engagement coil wire from start solenoid. Connect black tester wire to an appropriate ground and red lead to red harness wire at solenoid. Rotate ignition key to the start position. Meter should read battery voltage. Does it?</p> <p style="padding-left: 40px;">No→ Yes↓</p>	<p>With black tester lead on ground, check for voltage at large relay in terminal, circuit breaker in and out terminals, and across both sides (red and red/white) of the ignition switch with switch on start. Repair or replace any defective parts.</p>
<p>Reconnect solenoid, connect tester black lead to battery positive terminal and red tester lead to solenoid end of battery to solenoid cable. Turn key to start position. The reading must be less than .1V DC. Is it?</p> <p style="padding-left: 40px;">No→ Yes↓</p> <p>(B) Page 4.32</p>	<p>Clean battery to solenoid cable ends or replace cable.</p>
<p>Connect black tester lead to solenoid end of battery to solenoid cable and red tester lead to solenoid end of solenoid to starter cable. Turn key to start position. The reading must be less than .1V DC. Is it?</p> <p style="padding-left: 40px;">No→ Yes↓</p> <p>(C) Page 4.32</p>	<p>Replace starter solenoid.</p>
<p>Connect black tester lead to solenoid end of solenoid to starter cable and red tester lead to starter end of same cable. Turn key to start position. The reading must be less than .1V DC. Is it?</p> <p style="padding-left: 40px;">No→ Yes↓</p> <p>(D) Page 4.32</p>	<p>Clean solenoid to starter cable ends or replace cable.</p>
<p>Connect black tester lead to starter frame. Connect red tester lead to battery negative (-) terminal. Turn key to start position. The reading should be less than .1V DC. Is it?</p> <p style="padding-left: 40px;">No→ Yes↓</p> <p>(E) Page 4.32</p>	<p>Clean ends of engine to battery negative cable or replace cable.</p>
<p>If all these tests indicate a good condition, yet the starter still fails to turn, or turns slowly, the starter must be remove for static testing and inspection.</p>	

ENGINE ELECTRICAL

Electric Starter System Testing (Static)

Starter Motor Static Testing



A-E See page 4.31

- Remove starter motor and disassemble. Mark end covers and housing for proper reassembly.
- Remove pinion retaining snap ring, spring and pinion gear.
- Remove brush end bushing dust cover.
- Remove housing through bolts.
- Slide brush end frame off end of starter. **NOTE:** The electrical input post must stay with the field coil housing.
- Slide positive brush springs to the side, pull brushes out of their guides and remove brush plate.
- Clean and inspect starter components. **NOTE:** Some cleaning solvents may damage the insulation in the starter. Care should be exercised when selecting an appropriate solvent. The brushes must slide freely in their holders. If the commutator needs cleaning, use only an electrical contact cleaner and/or a non-metallic grit sandpaper. Replace brush assembly when worn to 5/16" (.8 cm) or less.

Starter Housing and Field Coil Inspection

- Using a digital multimeter, measure resistance between starter input terminal and insulated brushes. The reading should be .3 ohms or less.
- Measure resistance between insulated brushes and field coil housing. The reading should be infinite.
- Inspect insulated brush wire and field coil insulation for damage. Repair or replace components as required.

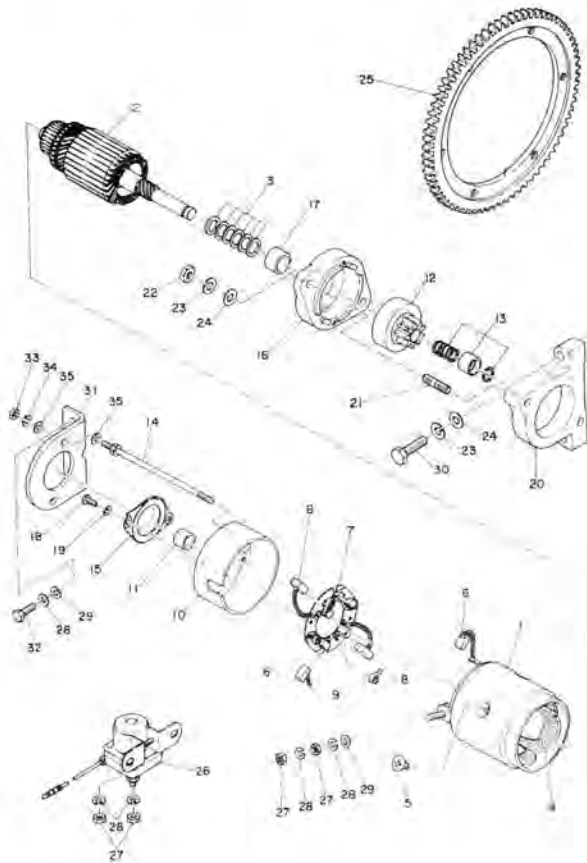
Armature Testing

- Using a digital multimeter, measure resistance between each of the segments of the commutator. The reading should indicate .3 ohms or less.
- Measure resistance between commutator and armature shaft. Reading should be infinity.
- Place armature in a growler. With the growler on, position a hacksaw blade lengthwise 1/8" (.03 cm) above armature coil laminates. Rotate armature 360°. If hacksaw blade is drawn to the armature on any pole, the armature is shorted and must be replaced.

ENGINE ELECTRICAL Electric Starter Reassembly and Reinstallation

Starter Reassembly

- 1 - Field Coil Housing
- 2 - Armature Assembly
- 3 - Washer Kit
- 4 - Field Coil
- 5 - Pole Core Set Screw
- 6 - Brush (+)
- 7 - Brush Holder
- 8 - Brush (-)
- 9 - Brush Spring
- 10 - Brush End Frame
- 11 - Brush End Bushing
- 12 - Pinion Assembly
- 13 - Pinion Stopper Set
- 14 - Through Bolt
- 15 - Dust Cover
- 16 - Drive End Frame
- 17 - Drive End Bushing
- 18 - Screw
- 19 - Spring Washer
- 20 - Engine Mounting Bracket
- 21 - Stud
- 22 - Nut
- 23 - Spring Washer
- 24 - Washer
- 25 - Ring Gear
- 26 - Solenoid
- 27 - Nut
- 28 - Spring Washer
- 29 - Washer
- 30 - Bolt
- 31 - Engine Mounting Bracket
- 32 - Bolt
- 33 - Nut
- 34 - Spring Washer
- 35 - Washer



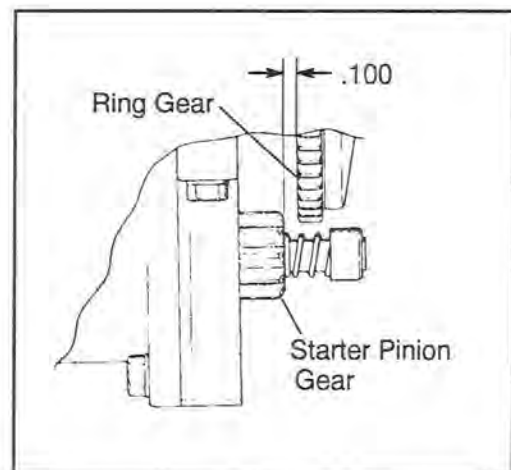
1. Slide armature into field coil housing.
2. Lightly grease drive end bushing and install drive end frame on armature.
3. Mount starter vertically in a vice with brush end up.
4. While holding negative brushes out against their springs, slide brush plate down onto the commutator.
5. While holding positive brush springs to the side, slide positive brushes into their holders and correctly position the springs on top of the brushes.
6. Using a non-petroleum grease, lubricate brush end bushing and slide it onto end of armature.
7. Align threaded holes in brush plate and install dust cover and screws.
8. Reinstall through bolts and properly tighten all screws.
9. Lightly grease pinion shaft and install pinion, spring stopper and snap ring.

Starter Solenoid Bench Test

It is difficult to test the high amp side of the solenoid accurately on the bench. The only test which can be done on the bench is the pull in coil resistance, which should read 3.4 ohms.

Starter Reinstallation

1. Position starter motor so there is no less than .100" clearance between the ring gear and the starter motor pinion gear.
2. Torque 8mm drive end mount bolts to 15 ft. lbs. (2.07 kg/m).
3. Torque 6mm brush end mount bracket to engine bolts to 5 ft. lbs. (.69 kg/m).
4. Torque through bolt mount bracket nuts to 30-42 in. lbs.





Electrical Fuel Injection
Section 4

ROM Identification / Charge Coil Test Specifications

Model	System Type	ROM ID	ROM PN	Battery Charge Coil Test Position/Resistance
1990 RXL	I	1990 V2	Contact Service Dept.	G to G/W .3 to .5 ohms
1991 RXL	I	FSM 582	4040032	G to G/W .3 to .5 ohms
1991 500	II	FSM 752	4040033	G to G/W .3 to .5 ohms
1992 RXL	I	FSM 582	4040032	G to B/W .2 to .4 ohms B/W to G/W .2 to .4 ohms
1992 500	II	FSM 752	4040033	G to G/W .3 to .5 ohms
1993 RXL	I	FSM 583	4040036	G to B/W .2 to .4 ohms B/W to G/W .2 to .4 ohms
1993 500	II	FSM 762	4040037	G to G/W .2 to .4 ohms
1994-1995 RXL	I	FSM 5B1	4040044	G to B/W .2 to .4 ohms B/W to G/W .2 to .4 ohms
1994 500	II	FSM 782	4040043	G to B/W .2 to .4 ohms B/W to G/W .2 to .4 ohms
1995 500	II	1995 500 V1	4040051	G to B/W .2 to .4 ohms B/W to G/W .2 to .4 ohms
1993-1995 RXL	II	1995 650 V1	4040057	G to B/W .2 to .4 ohms B/W to G/W .2 to .4 ohms

Optional ROMs for special applications

ROM ID	Part Number	Application	Description
1992 500 V2	4040038	1991-1992 500	For repeated lean failures and lean starts.
1994 650 HE1	4040042	1993-1994 RXL	For high elevation lean drive away. Calibrated for ethanol.

NOTE: FSM 5B1 and 1994 650 HE1 can be used for 1991-1992 RXLs, but may experience rich mid-range and reduced fuel economy.

The machines equipped with Polaris Electronic Fuel Injection (EFI) have many advantages over the normal carburetor equipped models. The most noticeable improvements will be ease of throttle operation, better cold weather starting and improved cold engine drive away. The EFI system also compensates for temperature and altitude, and with minor adjustments will perform well over a wide range of temperatures and altitudes.

To assist technicians in troubleshooting and understanding the EFI, we have divided it into three separate systems. The following is a short description of these three systems:

System I is battery, battery charging, and how the EFI is powered up or energized.

System II is fuel handling, fuel filtering, and fuel pressure regulations.

System III is electronics control, which includes the Electronic Control Unit (ECU), ECU inputs from various sensors, and control of fuel to the cylinders by injector operation.

The following information is a more detailed explanation of the three systems. It's very important during diagnosis that each of these systems be checked. Failure to do so may result in a reoccurrence of that particular problem.

Basic Operation - System I

Battery, Battery Charging and Powering Up

The battery is the heart of the EFI system, its condition is critical to all EFI functions. Long off-season storage periods, the high vibrations and extreme temperature variations which are encountered in snowmobile applications make periodic battery inspection and service essential.

Some Polaris EFI systems have an alternator or charging system which will produce just enough output to maintain the EFI system (1990-1991 RXL). If the battery is partially shorted, or if connections offer any high resistance, the result might be a lean fuel condition.

ENGINE ELECTRICAL

Electronic Fuel Injection Data

EFI models have two separate alternators or charging systems. One is used for lighting and accessories, the other for battery charging and EFI operation. The battery size and alternator size have been designed to provide adequate output for the EFI system. If your sled is equipped with electric start, a larger battery will be required to provide adequate cold cranking amperage.

CAUTION: At no time should any accessories be added to the battery or battery side of the charging system. To do so may overload the system, discharge the battery and cause substandard EFI operation.

To power up or turn on the EFI system, we have utilized different methods. To explain properly, we have to talk about the two basic EFI types:

TYPE I - The Type I system is used on all RXLs. To power up requires both key and auxiliary switches to be in the "Run" position. At that time, a circuit is completed between the battery positive terminal and the brown relay which passes through the switches and the circuit breaker. The brown relay then connects the battery directly to the ECU via the fuse link, causing the ECU to begin to function. The ECU connects itself to the battery via the self shut-off relay, which serves to maintain power to the ECU for approximately ten minutes after power is cut off by the key or auxiliary switches. The ECU is kept on for a short time in order to help prevent flooding of the engine during a restart a short time after the engine has been shut off.

When the ECU is first powered up, the fuel pump will run for approximately five seconds in order to build up fuel pressure in the rail. If the engine is stopped by the switches and then restarted within the ten minute period, the fuel pump will not repeat the five second run, since the ECU was kept powered up by the self shut-off relay.

If the engine is stopped or dies with the switches in the "Run" position, the ECU will remain powered up until the battery is drained.

TYPE II - The Type II system is used on all 500 EFI models. The 1991 and 1992 models power up differently than the 1993 and later models. The Type II system is similar to the Type I system in the way that it maintains power to the ECU after the engine stops, but is different in the way that it powers down. The Type I system depends on the operator to turn off at least one of the switches before the ECU will power down. The Type II system will power down regardless of the position of the switches in the event that the engine stops unexpectedly. This preserves battery power.

1991 And 1992 Model Type II Systems

These systems use a "READY" light on the dash panel to indicate that the ECU is powered up and "ready" to go. Power to the system does not pass through the auxiliary switch as it does on the Type I system. This switch only grounds the ignition system like those on carbureted engines. Power to the system is supplied primarily through the self shut-off relay and the key switch.

The key switch has three positions: OFF, RUN, and SYSTEM RESET/START. In the OFF position, the ignition is grounded. In the run position, the switch does nothing. It is not connected to any wire in this position. The SYSTEM RESET/START position is spring loaded, so the switch returns to the RUN position when the operator releases it. In the SYSTEM RESET/START position battery power is connected to the ECU via the fuse link, allowing the ECU to initialize and connect itself to the battery using the self shut-off relay. When the key switch is allowed to return to the RUN position, the ECU is powered only by the self shut-off relay.

If the engine is stopped the ECU will remain powered by the self shut-off relay for a period which varies with engine temperature. If the engine is warm the ECU will power down almost immediately. If the engine is cold it may stay powered up for as long as five minutes. The key only needs to be turned to the SYSTEM RESET/START position if the "READY" light is not on.

1993 And Later Type II Systems

These systems are similar to the earlier Type II systems in function, but do not have a "READY" light or a SYSTEM RESET/START position on the key switch. The key switch on these models only grounds the ignition in order to stop the engine. There is no battery power connected to the switch in these models, unless electric start is used.

This system uses an Alternator Controlled Switch (ACS) to power up the system. It is mounted on the battery box and also houses the voltage regulator/rectifier. This device senses the rotation of the crankshaft by recognizing output from the engine's alternator. It then connects power to the ECU just as the earlier Type II system does when the operator turns the key switch to the SYSTEM RESET/START position. This system eliminates the need for a "READY" light and a complicated key switch. The operator simply pulls on the rope and the system powers up automatically.

ENGINE ELECTRICAL

Battery Maintenance and Testing

Battery Maintenance And Testing

Battery maintenance is of the utmost importance to ensure satisfactory EFI operation. Partially shorted batteries can cause an additional load on the charging system and in turn leave the EFI system with too little to supply the relays, ECU, fuel pump, injectors, etc. When this type of machine enters your service area, be sure to thoroughly clean, inspect and test the battery.



CAUTION: It is extremely important that the battery condition and state-of-charge be maintained at the highest level possible or serious performance and driveability problems will arise. Battery testing procedures are covered below.

Off season storage for snowmobiles, especially EFI equipped machines, requires the battery to be removed. In the summer months we find higher temperatures and higher levels of humidity. These conditions, along with a small drain applied from the EFI system will in a very short time discharge the battery. Once the battery is discharged, the plates will become sulfated (turn white), and the battery will no longer accept a charge. Batteries which are not disconnected, removed and kept charged will need to be replaced at the beginning of each season. **Never substitute any battery of lesser quality when replacement is required. Batteries may be maintained by using the Polaris Battery Tender PN 2871076.**

Battery Service

Conventional battery service techniques apply to this battery. Maintain the specific gravity of the electrolyte to between 1.270 and 1.300. The open circuit voltage must be maintained to between 12.7 and 12.9 volts DC (at room temperature), at lower temperatures lower values may be OK. Voltage readings should always be taken with a fluke meter. The select monitor will place a load on the battery and on Type I units the monitor will incorrectly read the low volts (less than 10).

Battery Charging System Testing

<p>1. Adjust digital meter to DC volts and check battery voltage. Must be 12.4 volts or more (no load). If the select monitor is being used, the battery has been placed in a load and readings will be approximately .2 volts lower. Also, the select monitor on some models will not read accurate voltage below 12.0 and therefore should not be used. Does DC voltage read correctly?</p> <p style="text-align: center;">No → Yes ↓</p>	<p>Remove the battery. Service and test as outlined earlier in the engine electrical section. Before continuing, the battery must be in good serviceable condition and fully charged. IMPORTANT: Replace battery if questionable.</p> <p style="text-align: center;">Yes - See Block 2</p>
<p>2. Start engine and increase to at least 4000 RPM. Battery voltage should increase to 13.6 to 14.6 volts. NOTE: If battery is low on charge, the reading will be low. A fully charged battery will reach the higher number more quickly. Is voltage reading correct?</p> <p style="text-align: center;">No → Yes ↓</p>	<p>Check battery charging coil. Disconnect coil leads. Reference specifications for ohms values and connections. NOTE: These coils are open to ground, between any wire and ground should show open circuit. AC amperage testing will show approximately 7 amps at 4000 to 6000 RPM. Are tests OK?</p> <p style="text-align: center;">Yes - See Block 3 No ↓</p>
<p>3. Charging system is testing OK. Check for any possible loose connections between rectifier, regulator and battery. Are there any loose connections?</p> <p style="text-align: center;">No ↓</p>	<p>Replace lighting coil and/or flywheel. Re-test system. See Block 1.</p>
<p>4. Replace regulator rectifier and re-test system.</p>	

ENGINE ELECTRICAL

Power Up Testing - Type I RXLs

Reference correct wiring diagram in chapter 3.

1. Check battery voltage. Must be 12.2 or higher. Use digital fluke meter. Does it read correctly? No→ Yes↓	Charge, service, test and/or replace battery.
2. Check EFI brown relay. Y/BK wire should read 12.2 volts or more with switches turned on. Does it read correctly? No→ Yes↓	Check circuit breaker, key switch, kill switch, connections and wires. Check relay ground black wire.
3. Check brown relay. Relay should connect R/Y from fuse link to R/BK (ECU) and R/BLU (select monitor). Does it? No→ Yes↓	Replace relay and repeat tests.
4. Check self shut-off relay and wires from relays to ECU. Are tests OK? No→ Yes↓	Replace wires and/or relays.
5. Replace ECU.	

ENGINE ELECTRICAL **Power Up Testing - Early Type II, 1991-1992 500's**

1. Check battery voltage. Must be 12.2 or higher. Use a digital fluke meter. Is voltage OK? No→ Yes↓	Charge, service and test battery; or replace battery.
2. Check voltage between ECU Orange wire and ground, and between Y/Blk and ground. With key switch in the spring loaded position, voltage should read 12.2 or higher. Is voltage OK? No→ Yes↓	Check fuse link, key switch R/GR to R/W, and all wires and connections between battery to fuse link; fuse link to key switch, key switch to ECU. Are connections and components OK? Yes - See Block 3 No↓
3. Test self shut-off relay and circuits to relay. Are circuits and relay OK? No→ Yes↓	Repair and/or replace components or wires as needed and retest.
4. Replace ECU and retest system.	

ENGINE ELECTRICAL

Power Up Testing - Late Type II, 1993 to Current 500's

1. Check battery voltage using digital fluke meter. Must read 12.2 or higher. Is voltage OK? No→ Yes↓	Charge, service, and test battery; or replace battery. Continue testing if needed. See battery service.
2. Check voltage to ECU R/GN Pin #106. Should be 12.2 or higher. Is voltage OK? No→ Yes↓	Check circuit from battery through circuit breaker and to ECU. Repair and/or replace faulty wiring or components. Continue to step 3.
3. Check voltage to ECU O/BK wire Pin #11. Should be 12.2 volts while engine is being turned over. Is voltage OK? No→ Yes↓ See Also Block 5	Check for signal from battery charge coil to ACS G - GW wires. Is signal OK? Repair circuit if necessary. No - See Block 4 Yes↓
4. Check battery charge coil and connecting wires. Replace coil and/or repair wires. Continue tests.	Check for voltage from battery to ACS. Is circuit OK? Repair circuit if needed. Yes↓
	Replace ACS. Is system now OK? No↓
	Replace ECU and retest.
5. Check self-shut-off relay and circuit, OK? No→ Yes↓	Repair relay circuit.
6. Replace ECU and retest.	

Fuse Link

The fuse link is the circuit protection device in Type I and 1991-1992 Type II electrical system. Should a system overload such as a dead short occur, the fuse wire will open the circuit preventing further damage. If this link should open, find and correct the problem and then replace the fuse link. Never attempt to replace the fuse link with a conventional fuse. Use only an OEM fuse link.

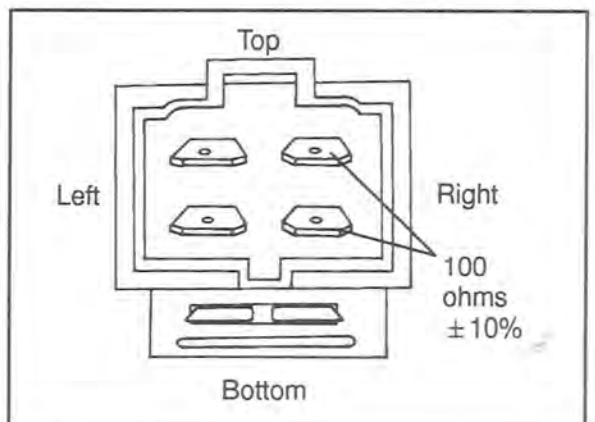
Service of the fuse link is limited to verification of whether or not the wire is continuous. Remove fuse link from machine and use an ohmmeter to determine resistance value of wire between plugs. Resistance values of less than .5 ohms indicate a good wire. Values greater than that will necessitate link replacement. Current models will use a self setting circuit breaker.

Relay Coils

The system relay coils are mounted on the front side of the right footrest assembly on Type I and 1991-1992 Type II systems. The relays for later model Type II systems are mounted on the ECU. Their function is to control a major current carrying circuit with a smaller, low current carrying control circuit. When the ECU or ignition switch closes the low current coil circuit within the relay, the magnetism in the coil closes the contact points, allowing current to pass through the relay and power up to the ECU, fuel pump, etc. Both system types incorporate two blue relays, one controlling the fuel pump and the other the self shut-off time delay relay. The Type I system also uses a brown relay to control the main power input to the ECU. On 1993 and later model Type II systems, the relays are black.

Service to relays is limited to measuring pull-in coil resistance and measuring volt drop across contacts. The coil resistance should be between 65 and 70 ohms measured between the two pins marked coil on relay base. When relay is energized, volt drop across relay contacts should be less than .1vDC, measured in parallel with relay. On the bench, the relay can be checked by hooking the marked relay coil terminals to a 12v battery and checking resistance of relay contacts. The resistance must be less than .2 ohms.

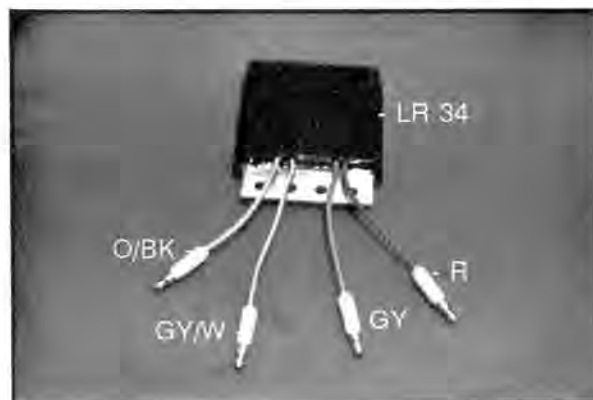
1993 and later Type II style EFI relays are tested by placing 12 volts to contact left side as shown in the diagram to the right. Measuring volt drop across contacts .1vDC. Measure resistance of right side contact. This should be 100 ohms \pm 10%.



ENGINE ELECTRICAL

Alternator Controlled Switch "ACS"

Shown is the (ACS) for the 1993 to current 500 EFI systems. The ACS controls voltage from the alternator by rectifying from AC to DC voltage current to charge the battery. It also supplies the ECU with a 12vDC battery voltage signal to indicate that the engine's crankshaft is turning. The ACS eliminates the need for the "Ready" light system reset as used on previous 500 EFI models. **NOTE:** Even if the key switch and kill switch are in the "off" position, the ACS will power up the system if the crankshaft is turned. (See also page 4.40, Power up testing.)



Test Procedure

With ignition in the on or run position, crank engine over slowly. You will hear the fuel pump run for approximately five seconds. This tells you the ACS is working. If the fuel pump doesn't work when cranking, disconnect ECU wire harness and reconnect to reset ECU. Crank engine again. If fuel pump won't start working, unplug the harness at the ECU and check Orange/Black wire PIN #11 on the ECU harness. Battery voltage should be present when cranking engine. **NOTE:** You can also use the select monitor to determine if the ECU is getting power. If the select monitor display lights up, then the ECU is getting power, check the ACS wire at the ECU plug. **CAUTION:** Take care not to distort the pin with your tester lead. If no voltage is present, reset ECU and check Orange/Black lead at ACS unit. If no voltage is present, check for alternator output or loose connections. If alternator output is OK, replace ACS.

NOTE: 1994 to current 500's will use a five wire ACS LR36. The extra wire is for a center tap alternator.

Cold Starting

Whenever the engine is being cold started, the ECU will select a special "start-up" mode. This will occur any time the engine is being cold started; for example, any Type I system which has been "key off" long enough for the self shut-off timer to power down the system, or a Type II system which has had the engine stopped long enough for the ready light to go off. After turning on the ignition key to reset the system, the fuel pump will run from three to five seconds to pressurize the system. When the ECU sees the first ignition pulse it provides a longer than normal "prime" pulse to the injectors to inject enough fuel into the engine for starting. On 1993 and later Type II systems, there is no ready light or ignition key reset. The pump may or may not run for the 3-5 second period depending on how long the engine has been off. In all systems, the "prime" pulse only occurs if the pump runs for the 3-5 second period.

Once the engine is running the ECU provides a rich cold engine mixture while the engine is warming up. It uses the engine temperature sensors as an indicator of when the engine is warm enough to start decreasing the fuel to air ratio. If the key is turned off, the ECU provides power to the self shut-off relay for from ten seconds to ten minutes, depending upon the system type, and will not repeat the fuel system pressurizing and prime pulse during that time. Once the self shut-off sequence has expired, the engine will have had sufficient time to cool and the ECU will again repeat the cold start sequence.

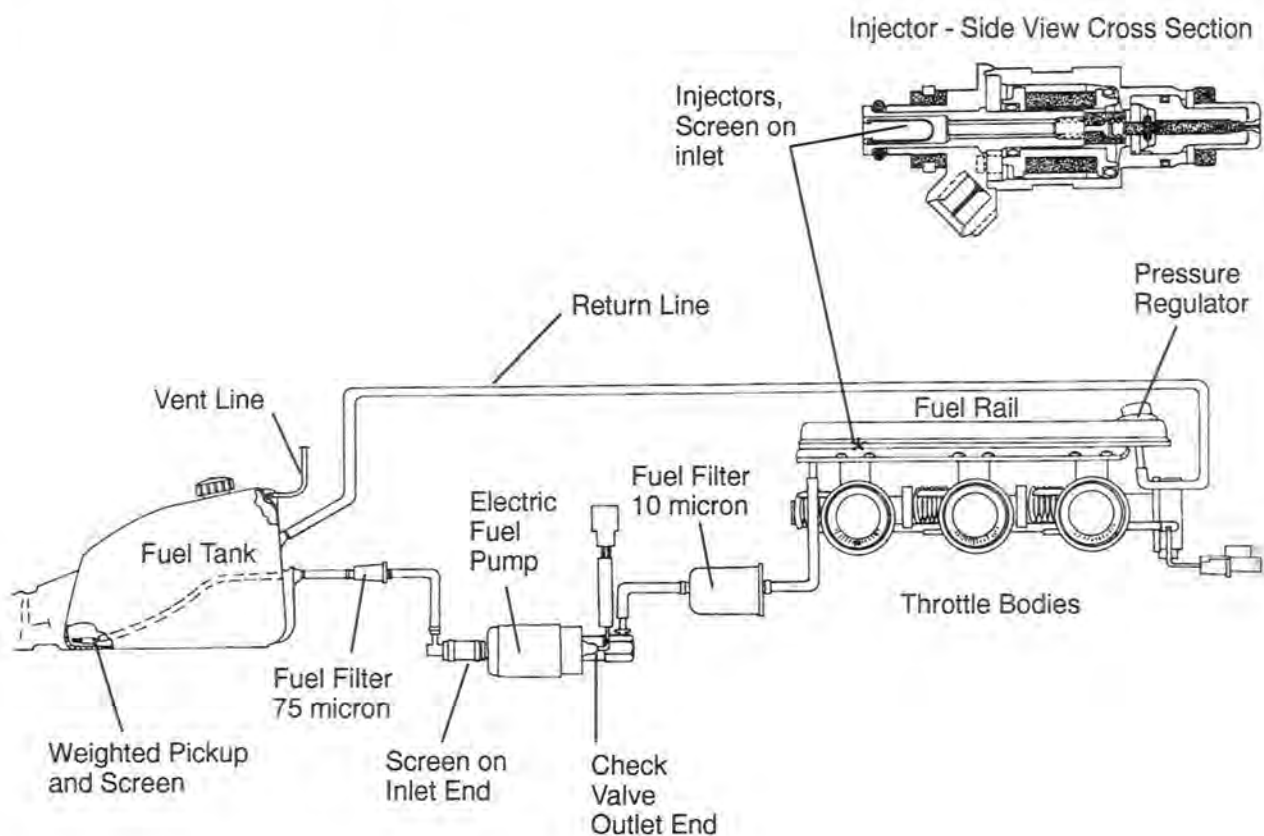
In Type I systems only, during times of severely hard running or in very warm weather if the engine crankcase should approach a temperature which might result in engine damage the ECU will provide additional fuel to the engine for cooling. When the crankcase temperature sensor indicates a temperature of approximately 100°C, the ECU will lengthen the pulse time and cause an over-rich condition which will cool the engine. As soon as the engine temperature returns to normal, the ECU will return to the original map.

If the engine should become flooded during starting, it can be cleaned out by holding the throttle wide open while turning the engine over. If the engine is not running, and the throttle is open more than 60°, no fuel will be injected. The engine will start and will begin receiving fuel from injection when the engine exceeds 800 RPM, or when the throttle position goes under 60°. The engine should then clean out and run normally.

In Type II systems, the engine is protected against overheating by the engine coolant sensor. If the engine coolant reaches a threshold (85°C 1993 and later, else 100°C) the "temp" light on the dash will begin to flash. If the engine coolant temperature continues to increase, the light will begin to blink faster. When the light blinks fast, the ECU adds fuel to enrich the mixture and to help prevent engine damage. The fuel will continue to be added until the light stops blinking.

ENGINE ELECTRICAL Basic Operation - System II

The fuel system consists of all the parts responsible for storing, cleaning, delivering, pressurizing and injecting fuel into the engine. They are: fuel tank, fuel pick-up, fuel hose, primary filter, fuel pump, secondary filter, fuel rail, injectors, throttle bodies, pressure regulator and fuel return hose. Tracing the path of fuel through the system, fuel is picked up from the bottom of the fuel tank by the fuel pick-up hose and filter. It then travels through a hose to the primary 75 micron filter, located under the carb air box. Once leaving the primary filter, it travels to the electric fuel pump, located under the mag end throttle body. The electric fuel pump is responsible for the movement of the fuel in the entire system. The fuel pump is connected to the battery by a relay. The pump runs continuously whenever the engine is started. Also located at the outlet end of the pump is a check valve. This valve holds pressure in the system when the pump has stopped.



After leaving the pump, the fuel goes through the secondary 10 micron filter for further purification. The secondary filter is located under the mag end throttle body. As you can see, cleanliness is essential to the operation of the system, and its importance cannot be overstressed. The fuel is then stored under pressure in the fuel rail, ready for discharge into the throttle bores. It is necessary to provide consistent pressure and to maintain a specific pressure in the rail. This is accomplished by the pressure regulator. The pressure regulator is pre-set to maintain rail pressure at a desired or specific pressure. Any pressure greater than the set pressure is relieved or returned to the tank by a return line.

ENGINE ELECTRICAL

EFI Fuel System Maintenance and Testing

Tank, Hose And Filters

The fuel tank is the reservoir for the fuel. It contains a flexible hose with a weighted pickup and a coarse screen which drops to the lowest part of the tank regardless of machine attitude. Fuel travels through the urethane fuel hose to the primary 75 micron filter located under the airbox and then to the fuel pump. From the pump the fuel hose changes to a reinforced rubber hose which carries fuel to the secondary 10 micron filter located under the throttle bodies, and then to the fuel rail.



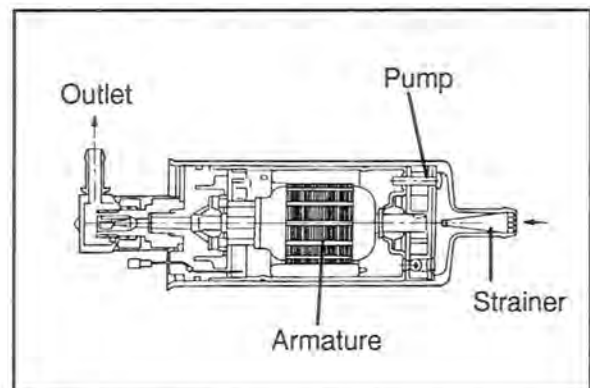
The fuel tank, hoses and filters require little, if any, service. Periodically inspect tank and hose condition. Assure that the pickup is clean and properly positioned and vent tube is properly routed and not kinked or pinched. Replace any hose showing signs of deterioration. Replace primary and secondary filters at 5000 mile (8000 km) intervals, every two years, or more often if contamination of any kind is present in the system. Use OEM parts only. If for any reason, at any engine RPM, the fuel system should fail to deliver a sufficient quantity of fuel to meet engine requirements and have some fuel returning to the tank, the fuel hoses must be checked for obstructions and/or the fuel filters replaced. If the problem does not rectify itself, proceed to fuel pump testing.

CAUTION: Whenever inspection reveals worn, damaged or defective parts, replacement is necessary in order to avoid serious damage to the machine or injury to the operator.

Fuel Pump

The electric fuel pump is located on the bulkhead underneath the mag end throttle bore. The 12v pump receives fuel from the fuel tank, then sends it through the small strainer in the pump inlet nozzle, through the roller vane type pump, through the outlet check valve and on to the injector rail. The pump is completely filled with fuel during operation. This provides cooling, corrosion protection and lubrication.

CAUTION: Never run the pump without a sufficient supply of fuel or pump damage will result. The pump is cooled and lubricated by fuel.



The pump outlet pressure can reach as much as 70 psi. It is regulated however to 35 to 37 psi by the fuel rail pressure regulator. Located near the outlet end of the pump is a check valve. The pressure regulator also acts as a check valve. There will be high pressure fuel between these two valves.

The fuel pump is a sealed unit. No internal repair of the pump components can be performed. Pump condition can be verified by an amp draw test, an output volume test and an output pressure test.

Amp Draw Test: Install a DC ammeter in series with the purple pump power feed wire. The draw should be 2.5 amps. A draw at or slightly less than that value indicates the pump is electrically sound. No draw indicates either no power present or an open circuit in either the pump or its ground. A draw greater than that value indicates either a stuck or defective pump. A pump which is stuck due to long periods of non-use can occasionally be freed by striking with a soft face hammer. If this does not free the pump, it must be replaced.

Output Volume Test: The output volume of the fuel pump and delivery system can be verified with an output volume test. To perform test, start machine and make sure delivery side of system is filled and pressurized to the pressure regulator. With machine turned off, disconnect fuel return hose and place it into a 200 milliliter graduated container. Activate ECU to cycle pump for approximately five seconds. The measured output during this time period should not be less than 90 to 100 milliliters. **NOTE:** Battery voltage less than 12.6vDC or restrictions in the fuel lines or filters will cause output to be less than recommended amount.

ENGINE ELECTRICAL

Fuel System Maintenance and Testing

Output Pressure Test: Install EFI fuel System pressure tester (PN 2870982) in fuel line on PTO end of rail. **NOTE:** Use caution when removing hose. The rail may contain pressurized gas if engine has been recently run. Activate dealer mode using select monitor service harness plug, by connecting gray and black test loads together or by jumping gray and black wire terminals at diagnostic plug, then turning on ignition switch. With pump running, system pressure should be between 35 and 37 psi. A pressure reading of higher than normal indicates a faulty pressure regulator or an obstructed fuel return hose. A pressure reading lower than normal indicates a faulty pressure regulator, a bad pump, or a restriction in fuel hoses or filters between tank and rail. If pressure starts out normal and then gradually lowers, suspect the fuel tank vent and/or any of the fuel filters or hoses which may restrict fuel delivery to the pump.

Fuel pressure can also be checked with the gauge in place and with the engine running. Pressure should be checked at both idle and at operating RPM. A plugged filter may show good pressure at idle but restrict flow at operating RPM.

Fuel Rail

The fuel rail is the fuel distribution manifold for the injectors. The injectors slip into fittings on the underside of the rail which are sealed with O-Rings around the injectors. The rail stores fuel under pressure so that simply opening the injectors will allow fuel to pass from the fuel rail through the injectors and into the throttle body. Pressure in the fuel rail is controlled by the pressure regulator.

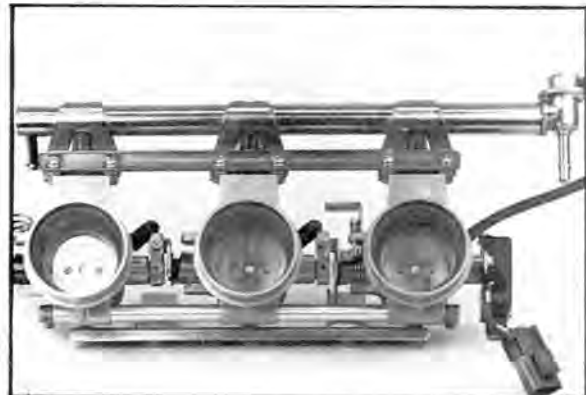
The fuel rail requires little if any service. Periodically inspect seal between rail and injectors and rail and regulator. If any leakage exists, replace O-Rings and recheck for leaks.

Return Hose

The return hose runs between the bottom of the pressure regulator and the top of the fuel tank. It provides a path for excess fuel from the fuel rail to return to the fuel tank. If this hose should become obstructed in any way, the excessive fuel pressure in the rail will cause a rich operating condition.

Pressure Regulator

The fuel pressure regulator is mounted on the opposite end of the fuel rail from where the fuel enters. Its function is to maintain a consistent fuel pressure within the rail by allowing pressure above the desired level to bleed off the rail, through the regulator, and back to the tank by way of the return hose. When the fuel pressure on the bottom of the regulator diaphragm reaches between 35 and 37 psi, it overcomes the spring on the other side of the diaphragm and pushes it up. This opens the valve to the return hose, allowing fuel to escape and maintaining a specific pressure.



ENGINE ELECTRICAL

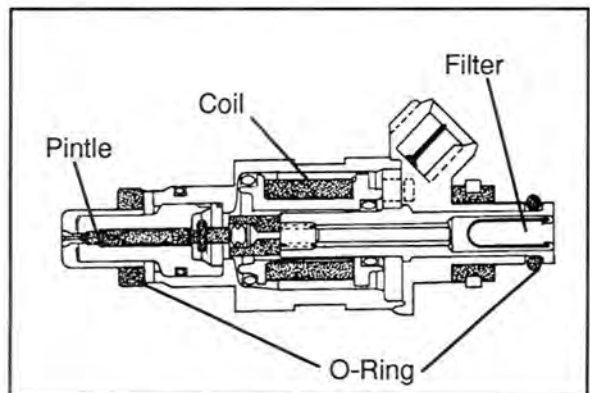
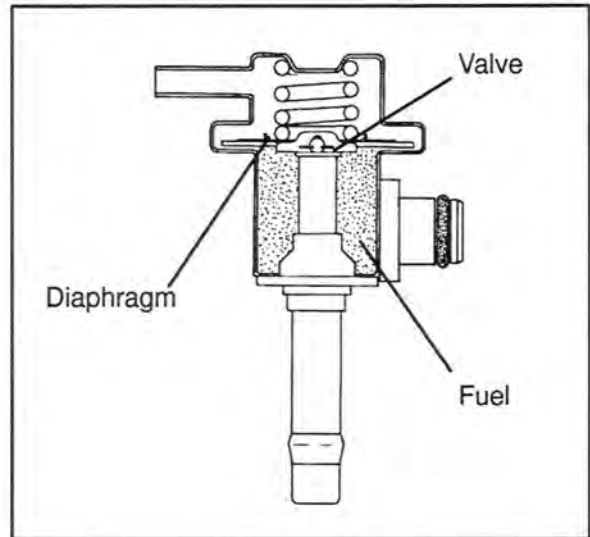
EFI Fuel System Maintenance and Testing

The regulator can also vary pressure consistent with engine load, atmospheric pressure, etc. A manifold pressure tube runs between the mag end throttle body and the top of the diaphragm. As the throttle is opened, the pressure in the throttle bore rises. This additional pressure enters the cavity above the diaphragm, assisting the regulator spring and raising the pressure in the rail, allowing more fuel through the injectors while they are open due to the higher pressure. The opposite is true during deceleration. High engine vacuum while the butterflies are closed is applied to the top of the diaphragm, allowing the fuel to compress the spring and open the regulator valve at a lower pressure. These pressure changes are very small and tend only to maintain a specific pressure differential between the throttle bores and the fuel rail, and not to vary mixture ratios while driving.

In addition to checks made under fuel pump service, the pressure regulator span can also be checked. With a fuel pressure gauge on the fuel line and a Mity-Vac™ pump (PN 2870975) installed on the regulator, activate the system the same as was done for the fuel pump check. The fuel pressure at atmospheric pressure should read between 35 and 37 psi; with five inches of vacuum it should be between 33 and 35 psi; with ten inches of vacuum it should read between 30 and 32 psi; and with five pounds of pressure it should be between 42 and 44 psi. Consistent readings outside the span indicate a bad regulator, bad hoses or filter, bad fuel pump, or an inaccurate test gauge. Verify the problem and correct it before any additional work is done to the system.

Injector

The injector is an extremely close tolerance solenoid type valve which opens and closes electrically. It allows fuel to pass from the fuel rail through the injector body and into the throttle body. The quantity of fuel is controlled by the length of time each injector is open, and constant fuel rail pressure.



ENGINE ELECTRICAL

EFI Fuel System Maintenance and Testing

1. Check battery voltage. Must be 12.2 or higher and be capable of handling pump load. If not, the fuel rail pressure test will be low. No → Yes↓	Charge, service, test and/or replace battery. See battery service section.	
Connect fuel pressure gauge and test as earlier outlined. Must read 35 to 37 psi. Pressure reading high→ Pressure reading low↓	Check for pinched or kinked pressure regulator return line. Is line OK? No → Yes↓	Clean or replace return line.
Inspect pump pickup lines, filters and volume test pump. Is volume OK? No → Yes↓	Replace pressure regulator.	
Replace pump.		

NOTE: It is very important to inspect fuel tank pick up screen and tank for floating plastic particles. It's possible to have particles collect around screen as pump is running and float away after pump has stopped running.

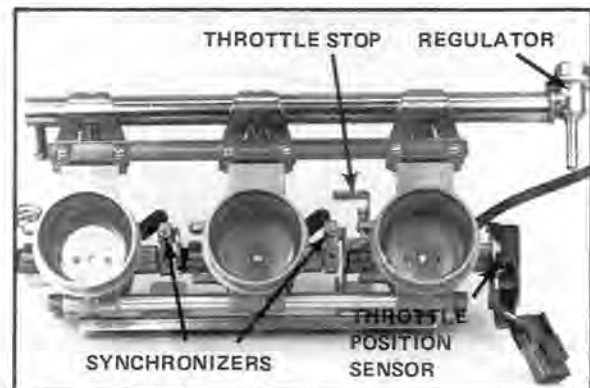
ENGINE ELECTRICAL

EFI Fuel System Testing

Injectors cannot be disassembled for service or cleaning. If a cylinder is not functioning properly and fuel supply is suspected as the cause, determine if an injector problem exists and whether it is mechanical or electrical. Switch the harness leads from the injector in question with an adjacent injector. If the problem moves to the adjacent injector, then it is electrical (see injector electrical service). If the problem stays with the same injector, then the problem is mechanical and injector replacement is necessary. If one of the cylinders fills with fuel after shutdown and the rail empties, remove airbox, open throttles, install a 1" (2.5 cm) wide strip of cardboard above butterfly and close throttles. Turn on ignition to pressurize rail. Wait two minutes and remove cardboard. Some wetting is OK, but a soaked cardboard indicates a defective injector. Some of the mechanical problems which will necessitate injector replacement are internal and external leakage, partial or total fuel blockage, open injector coil, and physical damage to the pintle and pintle case.

Throttle Body

The throttle body assembly replaces carburetors in a fuel injected type engine. It consists of one throttle bore unit for each cylinder which has the air flow controlled by a butterfly type throttle shutter. On top of each unit one injector is held in place by the fuel rail. The throttle position sensor is mounted on the mag end of the throttle body assembly. Engine idle RPM is controlled by the throttle stop screw mounted between the mag and center throttle bore units. Synchronization of the throttle assembly is accomplished by synchronizing adjuster between each pair of throttle bore units.



Since each cylinder and throttle bore operates independently and the only common factor is that they all get the same quantity of fuel, it may be necessary to periodically synchronize the throttle butterflies to coordinate the fuel/air quantities. This is best accomplished by removing the throttle body and visually synchronizing the butterflies on the bench.

Procedure

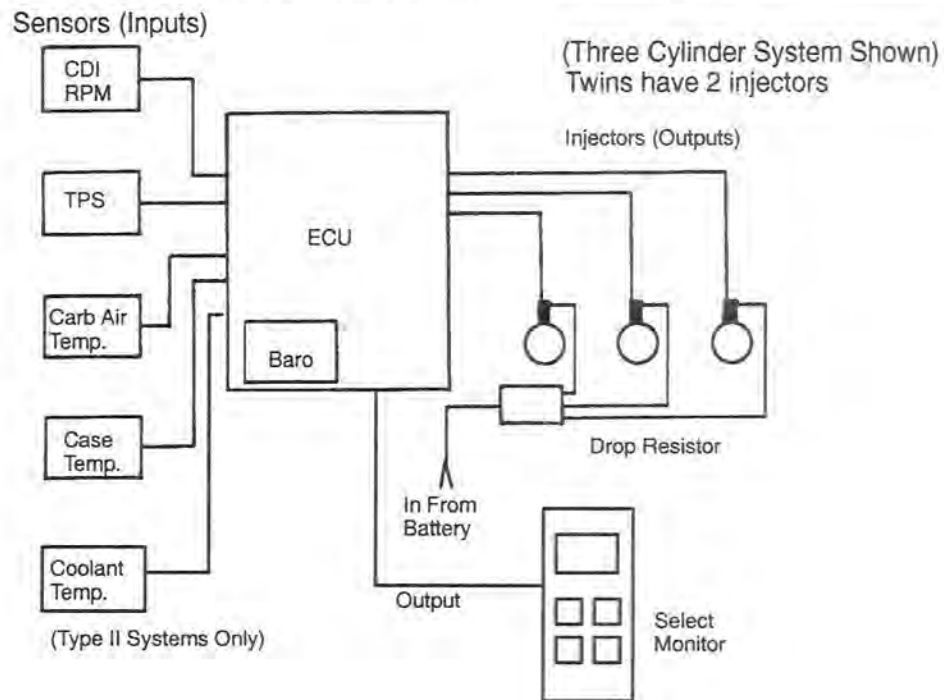
Loosen synchronizer jam nut between mag and center cylinder. Turn adjuster until center and PTO butterflies are farther open than mag side. While shining a flashlight into bore on engine side, view through air box side of mag throttle bore. Back out throttle stop screw until butterfly just closes at top of bore (no light shining through). Moving flashlight to center bore, adjust synchronizer until center butterfly just closes at top of bore. **NOTE:** Make sure the PTO butterfly does not hold the center open while adjusting.

Once center and mag butterflies are set to a just closed position, synchronize PTO butterfly the same way by adjusting synchronizer between center and PTO throttle bores until PTO butterfly is just closed. Open and close throttle three or four times by pulling up on cable attaching point on throttle shaft. Recheck all three butterflies to verify synchronization and readjust if necessary. Make sure that all synchronizer jam nuts are tight. Reinstall throttle body assembly on engine. The method for adjusting the throttle position sensor will be discussed under TPS.

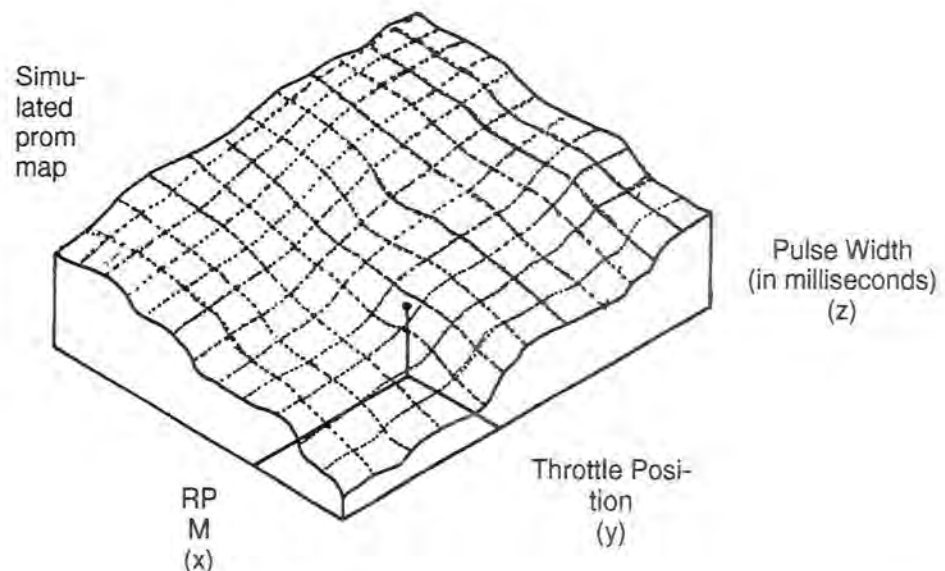
NOTE: The same procedure can be used on twin cylinder engines.

ENGINE ELECTRICAL System III - Electronics Operation

The Electronic Control System is the mixture control part of the system. It uses sensor inputs to control the fuel/air ratio. The illustration shows the components of the basic Electronic Control System.



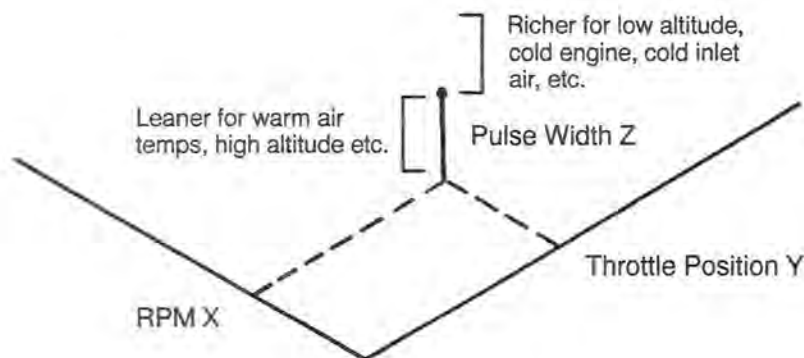
The electronic control unit delivers a low voltage signal to each sensor. Depending on variations in air temperature, throttle position, etc., each sensor will vary the amount of that signal passing through it to ground depending on its position and temperature. The ECU reads the information and from that determines what the actual air temperature, throttle position, etc. is. This information is then plotted on a map which is pre-programmed on the PROM (Programmable Read Only Memory) or "chip". Based on the two primary inputs; RPM (x) and throttle position (y), the ECU can select a specific injector open time (z). This value is the distance between the base plane and the map at the point where x and y cross. The value is converted to milliseconds and referred to as pulse width.



ENGINE ELECTRICAL

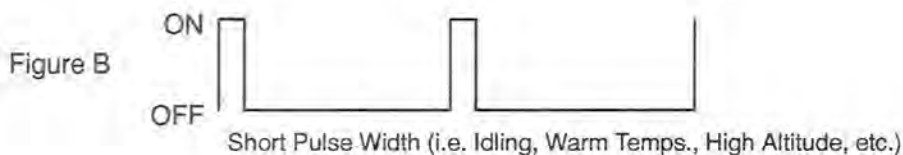
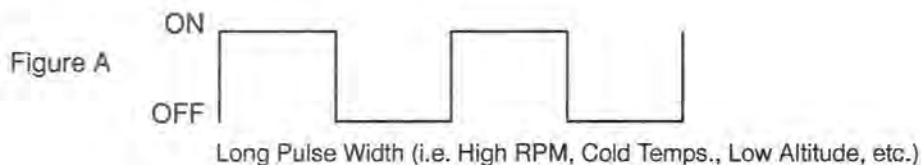
System III - Electronics Operation

Input from the other sensors either adds to or subtracts a percentage from the pulse width to tailor the fuel/air ratio for the specific altitude, air temperature and engine temperature. See illustration.



The illustration below depicts pulse widths in milliseconds output by the ECU. Figure A shows a situation where the air temperature is low, the machine is at low altitude with a cold engine, wide open throttle and high RPM.

The ECU determines the engine's fuel requirements and selects a relatively long pulse width which allows more injector open time for fuel to enter the engine.



If the same engine were at high altitude on a warm day at low RPM and throttle settings, the ECU would select a pulse width closer to Figure B, indicating a shorter injector open time and less fuel entering the engine. In this way the system can ultimately vary the mixture for all temperatures, loads and altitudes by varying the amount of time the injectors are open per revolution.

ENGINE ELECTRICAL System III - Electronics Testing

Select Monitor

The select monitor (PN 2870969) is designed to provide easy, accurate diagnostic and service information to the technician. When installed on the machine it will provide both dynamic and static displays of the function of critical fuel system control components. It also has the ability to display the contents of the ECU memory. With this tool, electrical service of the EFI system should be quick and easy.

Remove protective plug from diagnostic plug in machine harness next to ECU. Connect select monitor to instrument harness, to service harness, and to diagnostic plug in. Install program cartridge into select monitor. Turn on ignition switch and place handlebar kill switch into run position. Turn on select monitor switch. On most models the monitor display will now light up.

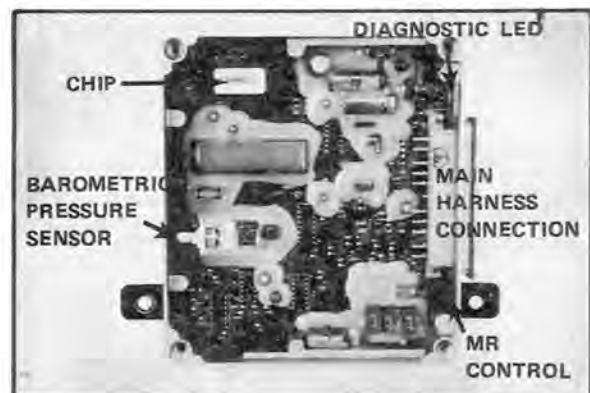
NOTE: On 1993 500 models, it is necessary to connect the Red/Yellow and Yellow/Green wire in the 5 pin electric start coupler with a jumper wire to maintain power to the ECU and select monitor. Type I models will stay powered up with switches on. On Type II systems, the time will be limited unless the engine is running. On 1994 and later models, the ECU will remain powered for approximately one minute at room temperature and above.

There are two ways to search for information with the monitor. You can scroll through the different modes in order until the correct information is found, or you can select the specific mode letter and number and advance to the specific information that you want.

Electronic Control Unit

The Electronic Control Unit (ECU) is the brain of the EFI system. It is a digital computer which holds the memory chip for the read out of basic injector opening duration on a three dimensional map. There are two ECU systems used, Type 1 for the RXL and Type 2 for the 500 EFI snowmobiles. Each system receives the same type of information from the sensors. The ECU incorporates a number of special features. Some of these features are: adjustable low speed mixture control, automatic cold engine start up enrichment, engine over temperature protection, flooded engine cleanout mode, failsafe feature and LED self diagnostic system. In the event that any sensor should give inaccurate or no information, the ECU will then flash a coded light sequence to identify the affected sensor. **NOTE:** It is important to note that the ECU will not identify mechanical problems. Only sensor inputs are monitored. For example, low fuel pressure or lack of fuel will not be diagnosed.

The ECU can only tell if a sensor reading is within a specific range. For example, a failure code will not be indicated if throttle position shows 3.9° when the throttle is actually wide open. Use display of throttle position to ensure the readings reflect actual conditions. This same concept applies to the temperature sensors and the barometric sensor.



ECU Part Numbers

Type I w/o chip	2410028
Type I w/o chip Elect. Start	2410029
Type II w/o chip	2410030

ENGINE ELECTRICAL

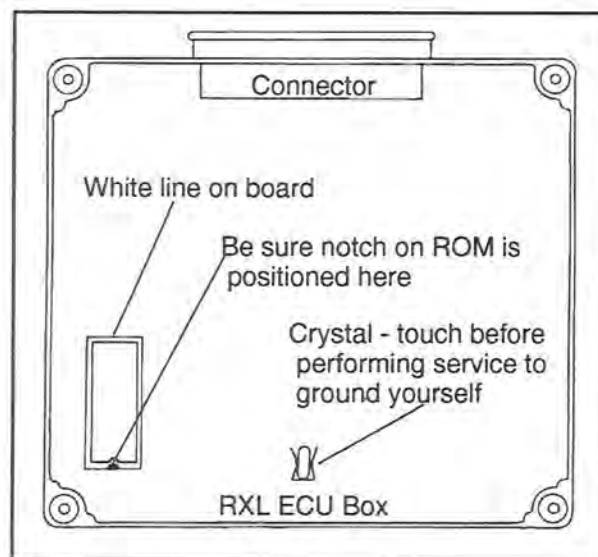
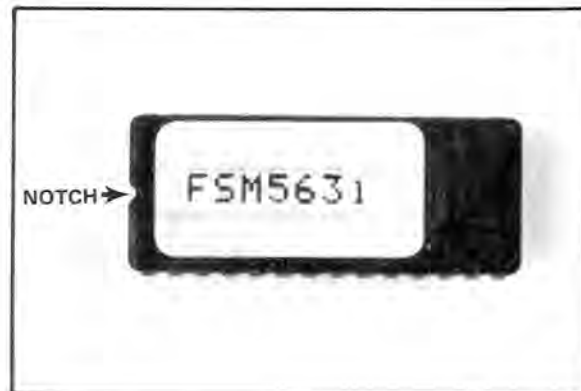
System III - Electronics Testing

ROM Chip Removal and Installation

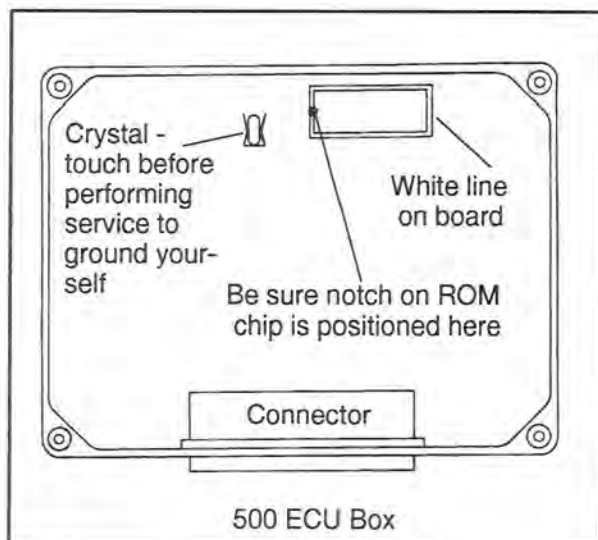
The chip can be removed and replaced with the appropriate chip puller and installation tool. You will need to supply ROM Removal Tool (Digi-Key PN K158-ND; Call 1-800-344-4539); and Nyogel (Polaris PN 2871044). Note the location of the indicator notch when replacing the chip (see photo). The system will not function with the chip in backwards or with the chip pins not properly in their sockets. See the specification section in this chapter for chip information.

CAUTION: The computer chip and the ECU are extremely sensitive to static electricity. The handling of either component in a static electricity environment will cause irreversible damage. Work on a metal bench or other static dissipating surface. It is very important that you ground yourself by touching the crystal inside the ECU before any internal service work begins on the ECU assembly. See the Illustrations 1 and 2. If the ECU has not been removed from the machine, be sure to unplug it before proceeding.

1. Disconnect main harness connector from ECU. Remove phillips head cover screws and cover.
2. Touch the crystal located inside the ECU box to ground yourself before proceeding. See Illustrations 1 and 2. **CAUTION:** The chip and the ECU are very sensitive to static electricity. Working inside the ECU without grounding yourself may cause irreversible damage to either or both components.
3. In the event you are removing an old chip for replacement, place ROM removal tool (Digi-Key PN K158-ND) over ROM chip. Pull up on triggers to securely grasp chip and pull chip out.
4. Check charts on page 4.35 to be sure you are installing the correct ROM.
5. Coat the pins of the ROM with a light coating of Nyogel (Polaris PN 2871044).
6. Carefully insert the ROM, making sure the notch on the end of the ROM matches the notch indication mark drawn in white on the circuit board. See illustrations 1 and 2. **CAUTION:** If the chip is installed with the notch incorrectly positioned the chip will be ruined and the machine will fail to run.
7. Align cover gasket, positioning cover rubber bumper above chip. Reinstall cover screws and reconnect wire harness. Install select monitor and check functions.



III. 1



III. 2

Troubleshooting EFI System

When key switch is turned to the on position, voltage is supplied to ECU and the select monitor. **NOTE:** Some models will require the engine to be turned over.

As explained on page 4.36, after the ECU is powered up, it will run the fuel pump for five seconds, read the sensors and do a self diagnosis of the complete system. The ECU does not check the Air Temperature Sensor (ATS) until the engine RPM is above 1000.

With a good understanding of how each component functions, the test procedures given in this manual, and the use of the select monitor, you will be able to service and diagnose the Polaris fuel injection system. All information and specifications are on the latest product information available.

Select Monitor Scrolling

With the ignition on and the monitor hooked up and turned on as described earlier, the display should show the year and the mode (F00). By pressing the ▲ key, the display will proceed to (F01) which is the model. Press the ▲ again and the (F02) will appear, which is battery voltage. By pressing the ▲ or ▼ keys, you can either scroll forward or backwards through the modes.

If you know the mode you want, service time can be saved by pressing "F" followed by the two digit number, and enter. The monitor will display the mode number and the registered information.

The following chart shows the modes, what the readings are for, and what an approximate reading should be.

Mode	Description	Normal Reading
F00	Model Year	Year of machine (not always correct)
F01	Engine Code	Polaris code number 30 for Triples; 20 for Twins
F02	Battery Voltage	12.2 or above at room temperature
F03	Engine RPM	Idle: 2000 to 2200 3 Cylinder; 1600 Twins
F04	Throttle Valve Angle (Whole Range)	0° to 77° large steps
F05	Intake Air Temp in C°	Room temperature (engine cold)
F06	Intake Air Temp in F°	Room temperature (engine cold)
F07	Crankcase Temp in C°	Room temperature (engine cold)
F08	Crankcase Temp in F°	Room temperature (engine cold)
F09	Barometric Sensor	Barometric pressure in millimeters of mercury
F14*	Throttle Valve Angle (Low End)	0° to 35.9° small steps
F21	MR (Idle Mixture) Position	2.5 or more than 4.0 for Alt. See page 4.58.
F22	Water Temp Sensor in C°	Same as ATS or CTS Cold or 30° to 90° running
FA0	Ignition Key Diagnostic	KY + No. 3 LED (with key on)
FA1	Dealer Mode	DM + No. 5 LED (with DM activated)
FA2	Relay Check	FP,SD,SS + No. 1,2, and 3 LED when operating
FB0	Existing Trouble Codes	Faults presently existing
FB1	Memory Trouble Codes	Faults that are intermittent
FC0	Memory Clear	—

*Not used on 1990 Type I systems

ENGINE ELECTRICAL

System III - Electronics Testing

The ECU determines the amount of fuel to be injected by accurately calculating the engine's needs for fuel delivery. In order to do this, the ECU is loaded with a memory chip for the read out of the three dimensional map which reads the throttle sensor and engine speed. Various sensors such as air temperature sensor, coolant temperature sensor, barometric pressure sensor, battery voltage and the MR setting in the ECU are also inputs to control fuel delivery.

Select Monitor Readings

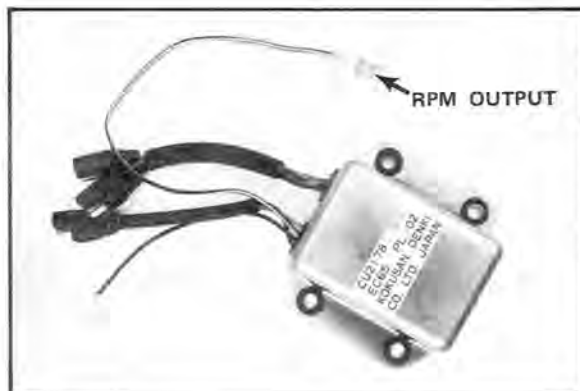
Mode	Description	Normal Reading
F100	Model Year	Year of machine
F01	Engine Code	Polaris code number 30 for Triples Polaris code number 20 for Twins
F02	Battery Voltage	12.2 or above

NOTE: Type I system will indicate a high battery voltage on the select monitor if the actual voltage is below approximately 10vDC. If you suspect a low battery, use a Fluke meter to directly measure the battery voltage. Type II systems do not have this problem. The select monitor accurately reads battery voltage.

RPM Sensor

The Electronic Control Unit receives an engine RPM signal from the CDI box. This signal is one of the main inputs and is very critical to proper operation. If the ECU does not see this signal, the injectors will not open and the fuel pump will only cycle for the initial five seconds when the ECU is powered up. (See page 4.36).

The ignition switch and auxiliary kill switch are connected in series with the ECU CDI signal. If these switches are leaking partial voltages to ground, the ECU will not function properly. Whenever CDI or intermittent running problems are occurring, the switches should be suspect for potential problems. These switches will also fail more often when humidity is high. To troubleshoot the switches, disconnect or isolate them from the circuit.

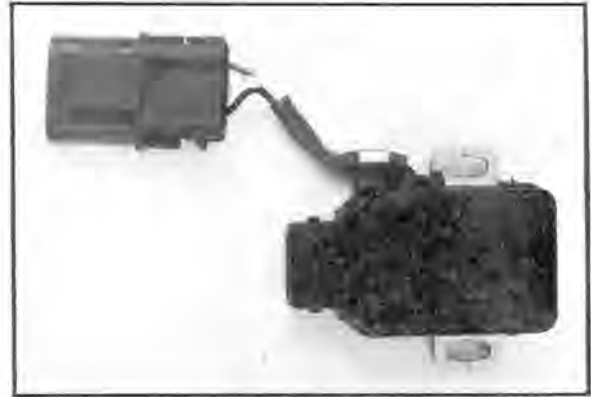


Select Monitor Readings

Mode	Description	Normal Reading
F03	Engine RPM	Cranking 300-500

Throttle Position Sensor (TPS)

Throttle position is one of the two main inputs used to calculate fuel/air ratio. The throttle position sensor is a rheostat type variable resistor which is mounted on the end of the throttle shaft. The resistance value of the sensor is relatively low at idle. As the throttle is opened, the resistance goes up proportionately to the butterfly angle. The ECU passes a specific current through the sensor and experiences more current flow at idle. This flow lessens as the throttle is opened. From this information, the ECU can determine butterfly angle and control fuel delivery accordingly.



The throttle position sensor can be checked on the bench with an ohmmeter. With the butterflies closed, the resistance between the black and white wire, measured at the plug, should be between 400 and 700 ohms. With the throttle wide open, the resistance should be approximately 4.5 k ohms. Some minor variations in resistance values will be experienced due to throttle position sensor location; but radical differences or failure to see a consistent progressive increase or decrease in the resistance as the throttle is opened and closed indicate a defective position sensor. The sensor can also be checked with the select monitor using mode F04. It should read between 3° - 4° when the throttle is closed and consistently, progressively increase with throttle opening to more than 74° at WOT. The throttle position sensor can be replaced by removing the two mounting screws and gently prying it off the end of the throttle shaft.

During periodic inspection, or when replacing the TPS, it must be synchronized to the throttle butterflies. The sensor must be positioned to the positive side of 0° with the butterflies totally closed. To adjust the sensor, disconnect the throttle cable from the throttle flipper and back out the throttle stop screw until the butterflies are totally closed. Connect the select monitor to the system diagnostic plug. Turn on the ignition switch and the monitor on/off switch. Scroll the monitor to mode F04 or F14 and verify the sensor positioning. **NOTE:** F14 is a low end scale for sensor adjustment. This is the desirable scale, but because of programming may not work on all models. Loosen the sensor mounting screws and rotate the sensor until the reading on the monitor is .1° on F14, or the point where the reading "breaks over" between 0° and a positive number on F04. Tighten the mounting screws, open and close the throttle a few times and recheck the reading. Readjust if necessary.

Select Monitor Readings

Mode	Description	Normal Reading
F04	Throttle Valve Angle-Range	0° to 77° Large Steps See TPS Adjustment
F14	Throttle Valve Angle Low End Not Used on All Systems	0° to 35° Small Steps Depending on Position

ENGINE ELECTRICAL

System III - Electronics Testing

Intake Air Temperature Sensor (ATS)

The air temperature sensor is mounted in the air box. Its function is similar to the crankcase temperature sensor in that its temperature will vary the resistance across the sensor. It has a reduced thermal capacity for quicker response.

Cold air will cause high resistance and warmer air will lower the resistance. The ECU sends current to the sensor and, depending on its temperature, a certain amount will pass through to ground. By measuring how much passes through, the ECU can calculate air inlet temperature and vary fuel/air ratio accordingly.



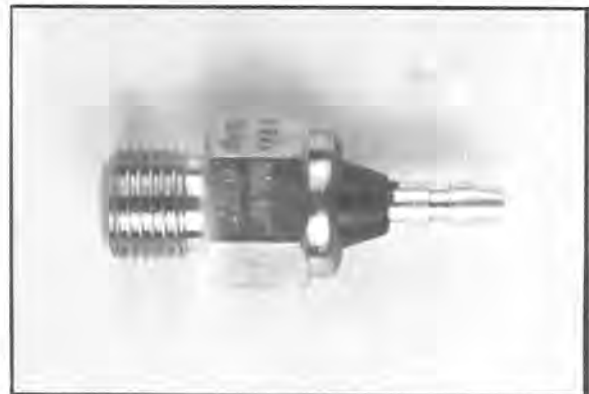
The intake air temperature sensor can be tested in a manner similar to the crankcase temperature sensor. Determine the approximate temperature of the sensor, measure the resistance between the two lead ends at the plug and compare the reading to the graph shown on the bottom of page 4.59. An easier and more accurate method is to use the select monitor to indicate what air temperature reading the ECU receives from the sensor. If the air box and underhood area have not been warmed due to recent running of the engine, the air temperature sensor should read room temperature on the select monitor. Radical differences between room temperature and the indicated reading indicate a problem with the sensor, wiring, battery, or ECU. Verify and repair any problem before attempting to operate the machine.

Select Monitor Readings

Mode	Description	Normal Reading
F05	Intake Air Temp °C	Room Temp "Engine Cold"
F06	Intake Air Temp °F	Room Temp "Engine Cold"

Crankcase Temperature Sensor (CTS)

The crankcase temperature sensor is screwed into the upper crankcase half below the mag throttle bore. This thermistor type semi conductor varies in resistance depending on its temperature. The ECU delivers an electrical current to the sensor. When the sensor is cold, its resistance is high and not much current passes through the sensor to the engine ground. As the sensor heats up its resistance lowers, allowing more current to pass through. The ECU measures the current flow through the sensor and knows the temperature of the engine crankcase and can vary fuel ratio according to case temperature.



The CTS is used on all Type I systems and on 1991 and 1992 model Type II systems. 1993 and later Type II systems do not use crankcase temperature sensor.

Select Monitor Readings

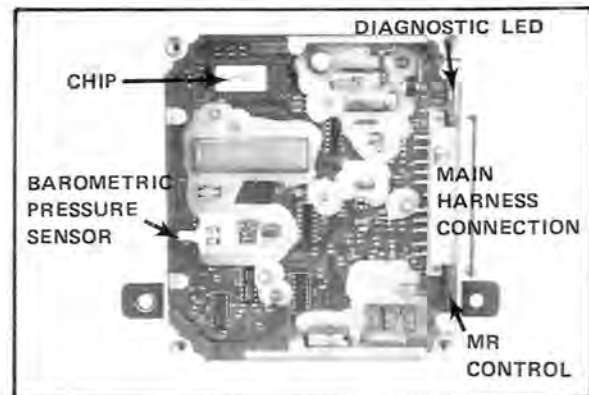
Mode	Description	Normal Reading
F07	Crankcase Temp °C	Room Temp "Engine Cold"
F08	Crankcase Temp °F	Room Temp "Engine Cold"

Barometric Pressure Sensor (BPS)

The barometric pressure sensor is located inside the ECU. Its function is to read atmospheric pressure. This information is then used by the ECU to determine fuel/air ratio, depending on pressure changes during a given day, or for any altitude change. The barometric pressure sensor is an integral part of the ECU and cannot be replaced separately.

No service can be performed on the barometric pressure sensor. However, the barometric sensor reading can be checked with the select monitor. The monitor reads in millimeters of mercury. To get air pressure in inches of mercury, divide this number by 25.4. Compare the reading to an accurate barometer.

NOTE: Readings reported by the radio or television are corrected to sea level. The select monitor is an actual reading. Any changes to the stock machine which affect the air pressure around the ECU will cause the barometric sensor reading to be inaccurate.



Select Monitor Readings

Mode	Description	Normal Reading
F09	Barometric Sensor	Barometric Pressure in Millimeters of Mercury

ENGINE ELECTRICAL

System III - Electronics

MR Adjustments

Fuel/air ratio at engine RPMs below 3500 can be adjusted slightly richer or leaner from the standard program mixture by adjusting the MR control. This adjustment is to compensate for individual engine differences on Type I and 1991 and 1992 Type II systems. This adjustment affects the same area as an air screw on a carb.

To adjust the MR control, remove the rubber plug. Install the select monitor, power up the system and press buttons F-21. A correct reading on the monitor is between 2 and 3, with 2.5 being the most desirable. **NOTE:** At high altitudes, a higher number will result in earlier drive-away after startup. Turning the MR screw clockwise will increase the observed number and richen the mixture. Turning the screw counterclockwise will lower the number and lean the mixture. The leanest setting will be 0 and the richest will approach 5.

Type II System - 1993 To Current

The production setting is 2.5. Adjusting the MR control screw on 1993 to current model 500s will only affect cold starts and cold drive-away. (It is designed to assist the driver when using poor or summer grade fuels.) If a lean condition is suspected, change the number to a higher value. If a rich condition is suspected, change to a lower number. Approximately two minutes after starting, this adjustment has little effect; after 10 minutes it has no effect.

Select Monitor Readings

Mode	Description	Normal Reading
F21	Mixture Enrichment	2.5

MR Adjustments For Altitude And Temperature

The following tables list MR screw settings for various temperatures and altitudes. Whenever performing MR adjustments, take the operator's riding location and weather conditions into account before making an adjustment. Numbers anywhere within the ranges listed should provide acceptable operation.

Type I Systems - 1990 Through Current RxIs

Production Settings 2.5

Ambient Temperature	Below +20°F (-6°C)	+20° to +50°F (-6° to 10°C)	Above +50°F (10°C)
0-3000 Ft. or 0-900 m	2.5	3.0-3.5	3.5-4.5
3000-6000 Ft. or 900-1800 m	3.0-3.5	3.5-4.0	3.5-4.5
6000-9000 Ft. or 1800-2700 m	3.5-4.5	4.0-4.5	4.5
9000-12000 Ft. or 2700-3700 m	3.5-4.5	4.0-4.5	4.5

Type II Systems - 1991-1992 500 EFIs

Production Settings 2.5

Ambient Temperature	Below +20°F (-6°C)	+20° to +50°F (-6° to 10°C)	Above +50°F (10°C)
0-3000 Ft. or 0-900 m	2.5	2.5-3.5	3.0-4.0
3000-6000 Ft. or 900-1800 m	2.5	3.0-4.0	3.5-4.5
6000-9000 Ft. or 1800-2700 m	2.5-3.5	3.0-4.0	3.5-4.5
9000-12000 Ft. or 2700-3700 m	2.5-3.5	3.0-4.0	3.5-4.5

Type II System - 1991 To Current EFIs

Type II EFI systems incorporate an engine coolant temperature sensor. This sensor is positioned in the engine water jacket where it is able to receive and relay reliable engine top end temperature to the ECU. This sensor also controls the temperature light and a fail safe mode. The "TEMP" dash light will come on and begin to blink slowly when the coolant reaches an unsafe temperature. If the temperature continues to increase, the light will begin to blink faster; at this time the EFI system will increase the fuel being supplied to the engine.



This increase in fuel will be noticed by a decrease in engine performance which is designed to protect the engine in an overheat condition. The increased fuel will continue until the engine coolant reaches a safe temperature and the light goes out. Correcting this problem may be as simple as driving the machine slower and/or driving in a snow condition which allows for more snow to be thrown onto the heat exchangers. If this condition continues, check the cooling system, coolant level, water pump belt tension, etc.

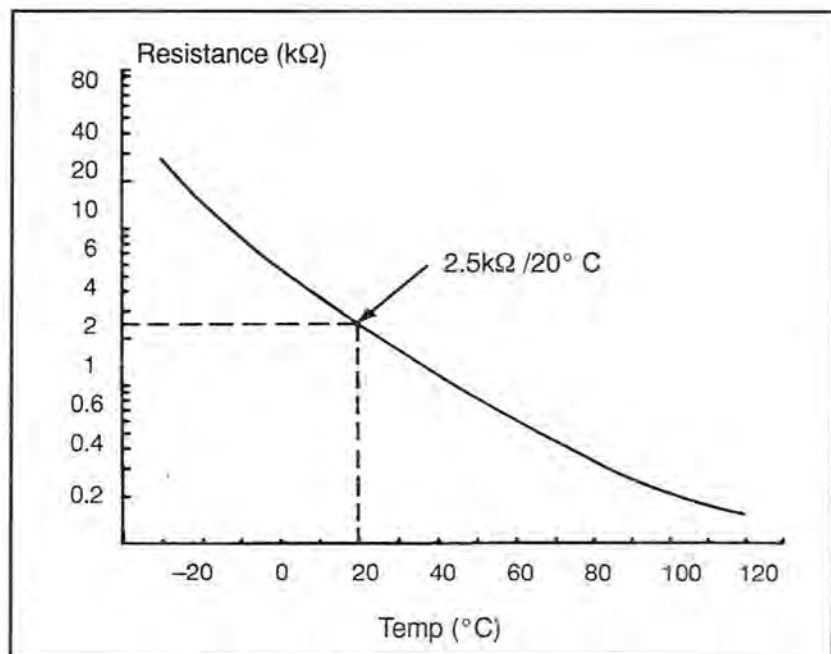
To check sensor function, connect a select monitor and advance to mode F22. With engine cold, observe reading. It should be near the readings of the ATS and CTS in degrees centigrade. Start engine and observe temperature increase as engine warms up. If readings vary greatly or fluctuate from other sensor readings, check harness and connectors for condition and repair as necessary. If no other problems can be found, and incorrect readings continue, replace sensor.

Select Monitor Readings

Mode	Description	Normal Reading
F22	Water Temp C°	Cold Engine Room Temp

Bench testing of a temperature sensor can be accomplished by measuring resistance between sensor wire terminal and sensor shell; then comparing reading to graph shown. An easier and more accurate method is to use the select monitor to indicate what temperature reading the ECU receives from the sensor. If the engine has not recently run, the sensor should read at or near room temperature. A radically different reading from room temperature could indicate a problem with sensor, wire to sensor, any of sensor connections, battery, or ECU. Verify and repair any problem before attempting to operate machine.

The sensor's resistance curve is shown at right. Resistance of the sensor is high when it is cold, and lowers as its temperature increases. This creates low current flow through the sensor at low temperatures and high current flow as the temperature increases. **NOTE:** The formula for converting °F to °C is ($^{\circ}\text{F} = ^{\circ}\text{C} \times 1.8 + 32$)



ENGINE ELECTRICAL

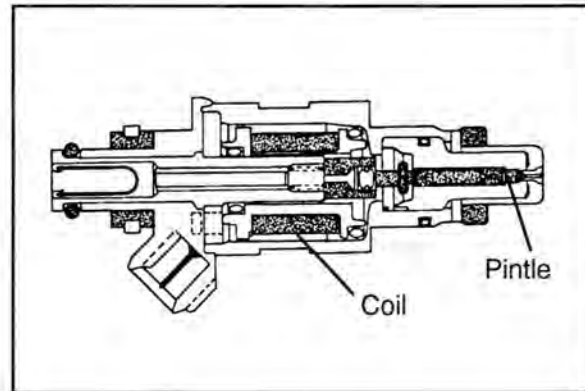
EFI Electronics

Fuel Injectors

Variation in the amount of fuel delivered per stroke to suit varying load and speed conditions can be obtained by controlling the discharge duration of the injector.

The injector is a solenoid-actuated constant stroke plunger consisting of a solenoid, plunger, needle valve and housing. The ECU will determine the duration time the injector is energized to deliver fuel.

The resistance between the two pins on the injector (isolated) should be 2 to 2.5 ohms. There should be no continuity to ground. **CAUTION:** Since the operating voltage is approximately 5 volts DC on the injectors, never attempt to test them with any higher voltage or the injector will be destroyed.



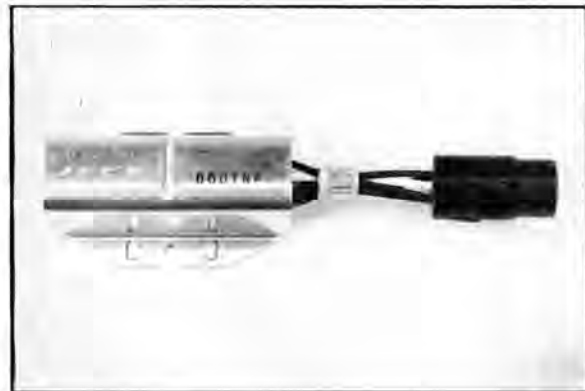
Select Monitor Readings

Mode	Description	Normal Reading
FBO-21	Type One System RXL Type Two System 500 EFI	Mag Side Injector
FBO-22	Type One System Type Two System	Center of PTO Injector on Twin Cylinders
FBO-23	Type One System	PTO Injector

Dropping Resistor

The dropping resistor is mounted on the engine side of the battery box. The three cylinder system consists of four individual resistors (only three are used) wired in parallel with a common voltage feed. The twin cylinder has two resistors wired parallel, also with a common voltage feed. They are used to drop or reduce the voltage going to the injectors to approximately 5 volts. Voltage from the battery travels through one of the resistors, through an injector and into the ECU. A failure of any injector or resistor will cause one cylinder to quit operating. The ECU will then flash the trouble code for that injector.

NOTE: The ECU can only determine electrical failure. If an injector failure code is flashing, the problem could be anywhere in the electrical circuit for that injector. The ECU will not find a plugged or leaky injector.



The dropping resistor may be tested with an ohmmeter between the white terminal and each of the black terminals at the resistor plug. The resistance is 6 ohms \pm 10%. Replace the resistor if any of the readings are outside of the spec. Clean the terminals if they become corroded. **NOTE:** The injector's operating power comes through these resistors. Any suspected injector electrical problem must first be traced through the dropping resistor.

ECU Diagnostics

If any of the main sensors should malfunction while the machine is being driven, the ECU will sense a problem and proceed to an over-rich "fail-safe" mode. An open or shorted circuit in any of the sensor circuits will show the ECU a reading outside of what it normally sees and the ECU will determine that a problem exists. Without this feature, certain kinds of failures could cause the mixture to be leaner than the required ratio and cause engine damage. This feature is important for engine protection. Once the sensor problem is determined and corrected, the ECU will return to the original map.

If any of the injectors or sensors should malfunction during operation, the ECU will record this information and start flashing a Light Emitting Diode (LED) code informing the mechanic/owner which component failed. The LED is on the right of the ECU, in front of the main plug. See ECU photo. If the problem still exists and is ongoing, the LED will continuously flash the code. If the problem occurred but the machine is now operating properly (intermittent), it will be stored in the memory and can be drawn out of the ECU by connecting the gray and black wires together at the diagnostic plug. The LED will then begin blinking long followed by short light pulses; then a pause and the long and short pulses again. The long pulses are the first digit in the code and the short pulses are the second digit. Compare the code to the following trouble code chart to determine the problem. Remember that the problem can exist in the sensor, the power feed to the sensor, the sensor ground, connectors, or the part of the injector or sensor circuit inside the ECU.

Select Monitor Readings

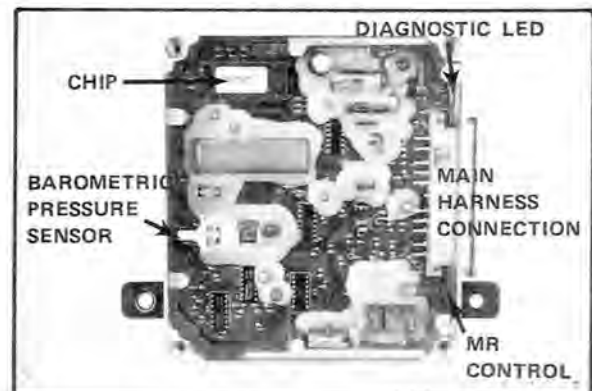
Mode FB0 is for existing problem diagnosis. Press buttons F, B, 0 and enter. If there is an existing problem, a code number and the abbreviation of the problem component will appear. See the chart for an explanation of the code numbers. The LED will also display this code. Example: Code 12- the light will display one long and two short pulses.

Mode FB1 is for retrieving trouble codes from the ECU memory. If a problem happened sometime during the machine's operation, but everything is operating properly at the present time, the ECU memory will verify which component was at fault. This is good for finding intermittent problems such as a wiring open or short. Press the F, B, 1 and enter buttons. If the display shows one of the above codes, check that component and its circuit. If nothing appears, there is nothing in memory. **NOTE:** If the ECU power is disconnected at any time, this memory will be erased.

Mode FC0 is used for erasing problem codes which are stored in the ECU's memory. To erase the problem codes, certain steps must be followed in order. First select the mode for the component which indicated a failure. Next, press F, C, 0 and enter on the monitor. The display will ask "Memory clear? 0=yes and 1=no". By pressing 0 and enter the memory will be erased. Indication of the memory being cleared will be a display of "Please key off".

Mode	Description	Normal Reading
FB0	Existing Trouble Codes	Faults Presently Existing
FB1	Memory Trouble Codes	Faults Which Are Intermittent
FC0	Memory Clear	Used to Remove Stored Information

Monitor and LED Code	System		Abb.	Component
	Type One	Type Two		
11	X	X	THV	Throttle Position Sensor
12	X	X	T Case	Crankcase Temperature Sensor
13	X	X	T Air	Intake Air Temperature Sensor
14	X		ALT	Barometric Pressure Sensor
14		X	TW	Water Temperature Sensor
15		X	ALT	Barometric Pressure Sensor
21	X	X	Inj 1	Mag Side Injector
22	X	X	Inj 2	Center Injector or PTO on Twins
23	X		Inj 3	PTO Injector
31		X	VB	Low Battery Voltage
32		X	VB	Low Charging System Output
33		X	CDI	CDI Output



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The FA modes are for testing the input and output functions from the ignition switch and the relays.

Type I System

With the select monitor on mode FA0, the display should show KY. Whenever the ignition switch and the handlebar kill switch are in the run position, the number 3 LED should also light. Cycle the switches a few times and observe that the LED goes off when the switches are turned off and re-lights when the switches are returned to the run position.

Advance the monitor to mode FA1 and connect the gray and black dealer mode wires together on the monitor's service harness. The monitor display should read DM (Dealer Mode), and the number 5 LED should be lit. During dealer mode operation, the fuel pump will cycle on and off in one second intervals and any stored problem code will flash on the ECU's LED.

Advance the monitor to mode FA2 and the letters FP (fuel pump), SD (self diagnostics) and SS (self shut-off) will appear on the display. Whenever the EFI system is in the normal run mode the number 1 LED will be lit when the fuel pump is required to run. This will be for five seconds when the key is initially turned on, and whenever the ECU senses engine ignition pulses. The number 3 LED will be lit when the key is turned on and will go out ten minutes after the switch is turned off. When the dealer mode wires are connected together at the service harness, the ignition key is cycled off and back on, and the select monitor returned to mode FA2, the number 3 LED will not be lit. The number 2 LED will flash any problem codes which are in memory in the ECU and the number 1 LED will flash off and on in one second intervals.

Type II System

With the select monitor on mode FA0, the monitor should show an ST and DM on the left, and a KY on the right of the display. The number 1 and 5 LEDs will light when the key is rotated to the start/reset position. The number 6 LED will light when the gray and black dealer mode wires are connected together on the service harness. The fuel pump relay will only cycle on and off for three one second runs each time the system is reset while in dealer mode.

Due to the different operational method used in the Type Two system, there is not an FA1 or FA2.



